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Learning About Quality

How the Quality of Military Personnel Is Revealed Over Time

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PREFACE

This report explores the quality of U.S. enlisted personnel in the first term of service. The measure of quality in the report extends the customary definition of quality—i.e., high school diploma graduate and scoring in the upper half on the Armed Forces Qualification Test (AFQT)—to include performance as indicated by speed of promotion during the first term. We find that a large amount of information about a service member's quality is revealed during the first term. Our research suggests that future assessment of personnel quality and of policies that affect quality should employ measures of quality that reflect both entry-level measures and performance in service. According to the measure of quality developed in the report, the services retain higher-quality members although they tend to lose members with higher AFQT scores.

The report was prepared under the sponsorship of the Office of Under Secretary of Defense for Personnel and Readiness. The research was conducted within the Forces and Resources Policy Center of RAND's National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the unified commands, and the defense agencies.

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SUMMARY

The traditional measures of enlisted personnel quality are high school diploma graduate (HSDG) status and Armed Forces Qualification Test (AFQT) score. These measures are valid predictors of the completion of advanced individual training and of nonattrition; they are available prior to service and so are useful in recruiting. However, because they are entry-level measures, they contain no information about a member's quality as it is revealed "on the job." The intention of this research is to present and apply a novel method developed by Ward and Tan (1985) that expands the measure of quality to include information about a member's performance as it is revealed through promotions.

To establish a conceptual basis, we present a model of employer learning about employee quality. In our context, "quality" is understood as the quality of the job match between the member and the military. The quality of the match may depend on the member's ability, effort, and taste for the military; it is not a measure of ability alone. The promotion process reveals quality by establishing criteria that apply to all members and by promoting faster those members who are soonest to meet and surpass the criteria. Thus, the member's speed of promotion relative to that of peers is a yardstick of a member's quality. To establish the notion that quality is a persistent characteristic, not just a one-time, random-speed promotion outcome, we present descriptive information showing that members who are faster to pay grade E-4 are also faster to pay grade E-5, holding AFQT score constant.

Our application of the Ward-Tan quality model has three structural equations. The first equation states that quality is a function of AFQT and a member-specific quality factor. The second and third equations state that the E-4 and E-5 promotion-hazard functions depend on quality. A promotion-hazard function indicates the probability of being promoted at time *t* given that one has not yet been promoted. The functional form allows the promotion-hazard function to shift upward or downward with the level of quality, and we expect higher quality to shift the promotion hazard upward. The higher the promotion-hazard function, the shorter the expected time to promotion. Although we cannot directly observe quality and its individual components, we can estimate the full model by means of the action of quality on the promotion hazards. Using the estimated model, we can compute the expected value of the individual quality component and also compute the member's overall quality. The computation can be done for each member for each month of the first term. Thus, like the AFQT score or the HSDG status, the estimated quality is member-

specific. Moreover, its value is updated in a way that depends on the member's promotion speed relative to that of the member's peers. The updating process implements the notion of learning about quality while a member is on the job. This report describes the empirical model in detail.

We applied the model to a specially constructed longitudinal data set of all enlisted members joining the military between fiscal year (FY) 1979 and FY 1992. Because promotion tempos differ over time, among specialties, and among the services, we estimated separate models by specialty and service for each cohort in which the number of members in the specialty was large enough to permit estimation (roughly, 500 or more members). Whereas Ward and Tan estimated eight models (two specialties per service for the 1974 cohort), we estimated 334 models over 14 cohorts.

We addressed three questions with the estimated models. First, is AFQT score positively related to the member's overall quality, as expected? We find this to be true in nearly all cases. Second, what is more important with respect to overall quality, the contribution of AFQT or the contribution of the member-specific quality factor? We address this question by considering the variance of overall quality; we partitioned this variance into the variance from AFQT and its effect on quality and the variance from the member-specific quality factor. We find that on average across occupations, the member-specific quality factor accounts for 92, 54, and 87 percent of the variance in overall quality for the Army, Air Force, and Marine Corps, respectively. AFQT accounts for the remainder. The importance of the member-specific quality factor is in line with theoretical literature (e.g., Gibbons and Waldman, 1999) that assumes organizations have imperfect knowledge about employee quality but can learn about it from the employee's performance on the job. Third, are higher-quality members more likely to reenlist? The answer is yes, and this is so despite the fact that AFQT by itself typically has a slight negative relationship to reenlistment. Our research indicates that by the end of the first term, members have sorted themselves into civilian and military careers based on the quality of job match as revealed over their term. Members with a higher overall quality of job match with the military tend to stay in the military, whereas those with a lower quality of job match tend to leave.

Because we estimated quality from information on a member's promotion speed relative to peers, the validity of the finding that the military tends to keep its high-quality members depends on the validity of the promotion system in identifying those members. We have not conducted a separate study to validate promotion as a measure of job performance. We proceed on the assumption that promotion criteria, which involve duty performance, skills and knowledge, physical fitness, awards and decorations, and education, are useful indicators of quality. We think the member-specific quality factor depends on a member's ability, effort, and taste for the military; the quality of job match does not reflect ability alone. However, if quality depends on ability, effort, and taste, the military might be concerned that high-quality members stay mainly because of their taste and effort and not because of their ability. But this seems unlikely. We know that promotion depends on performance on duty and on the acquisition of skills and knowledge. We expect members with high taste for the military to exert more effort to acquire skills and knowledge and to perform well on duty. Regardless of their taste for the military, members with high abil-

ity can presumably acquire more skills and knowledge and perform better with a given amount of effort.

We also hypothesize that ability and taste for the military are not correlated. If our hypothesis is correct, both high- and low-ability members may have high taste and high effort, but those high-taste, high-effort members who *also* have high ability will be promoted faster. There is thus no reason to suspect that the members we estimate to be high-quality are mainly high-taste, high-effort, low-ability members.

If taste and ability were negatively correlated, it is possible that members estimated to be high-quality would also tend to be low-ability—but again this seems unlikely. AFQT score is an observed measure of ability, and it seems reasonable to expect a positive correlation between AFQT score and unobserved aspects of ability. Yet as mentioned, there is only a slight negative relationship between AFQT and reenlistment, and high-AFQT members do not leave en masse. By the same token, if AFQT is positively correlated with other aspects of ability, there is little reason to suspect that only high-taste, high-effort, low-ability members remain in service. It seems more likely that the high-quality members who reenlist tend to have high taste, high effort, and at least reasonably high ability.

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ABBREVIATIONS

AFQT	Armed Forces Qualification Test
ASVAB	Armed Services Vocational Aptitude Battery
BGH	Baker, Gibbs, and Holmstrom
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DSCAC	DMDC Special Cohort Accession and Continuer
GW	Gibbons and Waldman
HSDG	High School Diploma Graduate
MIMIC	Multiple-Indicator, Multiple-Cause
TIS	Time-in-service

Chapter One

INTRODUCTION

WHY A NEW MEASURE OF QUALITY?

In this research, we present and apply a method that can be used to increase the amount of information available on the quality of enlisted personnel. Policymakers and analysts have traditionally relied on two measures of enlisted personnel quality—high school diploma graduate (HSDG) status and Armed Forces Qualification Test (AFQT) score. These measures have the advantage of being available at the time of entry into military service, and they are valid predictors of completing training, completing the first term of service, and performing well on written and hands-on tests of skills and knowledge. But although they are valid predictors, they do not provide information about actual performance during the first term. Just as high SAT scores do not guarantee academic success, high entry characteristics do not mean that members will perform well in service. Furthermore, some members who enter with lower entry characteristics may prove to be high performers in the service. The method we present offers a means of incorporating information about first-term performance into the measure of enlisted personnel quality.

Our information comes from the promotion system. To extract this information, we extended the work of Ward and Tan (1985), who adapted the multiple-indicator, multiple-cause (MIMIC) model formulated by Goldberger (1972). The promotion system bases advancement on criteria that reflect acquired skills and knowledge, physical fitness, duty performance, awards and decorations, and education and training. Members who attain and surpass the criteria more rapidly are promoted faster than their peers. Thus, the relative speed of promotion can be used to infer information about a member's quality. Because promotions refer to a member's progress within the military, the dimension of quality revealed by promotion concerns the quality of a member's job match to the military. This is different from an AFQT score or a high school diploma, which are not job-contextual measures of quality. We think of AFQT and education as general measures of quality, and performance on the job (in our case, as revealed by promotions) as a measure of the quality of the match between the individual and the organization.

The new measure of personnel quality has a number of applications. It can be used to determine whether members with a higher quality of job match to the military are more likely to be retained by the military. This report examines first-term reenlist-

ment, and future work will address retention and promotion beyond the first term. The new measure can also be used to determine whether members with a high quality of job match to the military are more likely to reach positions of higher rank and greater responsibility. Because the quality measure is member-specific, particular occupations—e.g., medical, aircrew, communications, weapons, intelligence—can be studied intensively. Finally, the new measure can be used in policy analyses to determine whether a policy has a different effect on members with a high quality of job match than on members with a low quality of job match. Possible policy actions might include changes in pay, reenlistment bonuses, education and training opportunities, promotion speed, and work intensity.

JOB HIERARCHIES AND IMPERFECT INFORMATION ABOUT WORKERS

We assume that an organization has a hierarchical structure and that its workers may progress up the structure depending on their skills, knowledge, leadership, ability to communicate, ability to work in teams, reliability, and judgment. Each of these characteristics is a form of human capital that can be increased through investment and can depreciate through obsolescence or disuse. We assume the acquisition of human capital is positively related to a worker's education, training, and experience and further, that human capital can be acquired more rapidly if ability and effort are higher. Generally speaking, any organization wants to attract workers with high ability and a high willingness to exert effort. It wants its compensation and personnel management policies to induce these workers to remain with the organization, exert effort, and strive to progress up the job ladder—and it wants to place the most capable workers in the highest positions (Lazear and Rosen, 1981). Because ability and willingness to exert effort are difficult to observe and measure, entry-level screens such as AFQT and HSDG result in imperfect information. More information, however, can be obtained from measuring performance on the job. Furthermore, the worker might not know at the outset how much effort he or she is willing to exert on the job. Although this may depend on the organization's compensation structure and personnel management practices, the amount of satisfaction the worker derives from the job may be equally important. The level of effort the worker needs to exert for the job may also depend on the worker's aptitudes for the job, which might be imperfectly known to both the worker and the organization at the outset.

Gibbons and Waldman (1999) recognized that organizations have imperfect information about workers. Their objective was to determine a small set of theoretical building blocks sufficient to explain wage and promotion dynamics in large, hierarchical firms (Baker, Gibbs, and Holmstrom, 1994a,b). They could do so only when their model allowed for learning about "ability" through performance on the job. We discuss the Gibbons and Waldman model further in Chapter Two.

IMPERFECT INFORMATION ABOUT RECRUITS

The military, like other large organizations, screens its recruits. Would-be recruits may be screened out by mental, moral, or medical factors. Among recruits, those

who have a high school diploma and who score in the upper half of the AFQT score distribution are termed *high-quality* recruits.

High school diploma graduates are far more likely than high school dropouts to complete their first term of service (see, e.g., Buddin, 1984; Antel, Hosek, and Peterson, 1989). Compared with dropouts, high school graduates have been described as having the "stick-to-it-iveness" to complete initial training, advanced individual training, and first-term duty assignments. Yet high school graduation status is a limited measure. It provides no information on the quality of the high school or the individual's curriculum, grade point average, class rank, and aptitudes.

The services use the Armed Services Vocational Aptitude Battery (ASVAB) to measure aptitudes. Because the ASVAB was normed on a representative sample of youth, the scores of test-takers can be compared with one another. The ASVAB contains ten subtests: General Science, Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, Numerical Operations, Coding Speed, Auto and Shop Information, Math Knowledge, Mechanical Comprehension, and Electronic Information. The AFQT score equals the sum of the standard ASVAB scores on Arithmetic Reasoning and Math Knowledge, plus twice the sum of the standard scores on Paragraph Comprehension and Word Knowledge. Broadly speaking, the AFQT score reflects verbal and quantitative aptitudes.[1] The AFQT was designed to screen for persons not likely to complete training within a reasonable time.[2] Analyses have also shown that AFQT score is related to proficiency in operating complex weapons systems such as tanks (Baldwin and Daula, 1985), the Patriot missile (Orvis, Childress, and Polich, 1991), and multichannel communications equipment (Winkler, Fernandez, and Polich, 1992).

Despite the information about quality provided by HSDG and AFQT, we can see the importance of additional aspects of quality by looking at first-term promotion curves. Enlistees move through the first three ranks—E-1, E-2, and E-3—at virtually the same pace, so we focus on promotion times to E-4 and E-5, which vary among individuals. As Ward and Tan reasoned, if fast promotion to E-4 indicates only a randomly good outcome, it should be unrelated to the time to E-5 promotion. But if it were caused by an unobserved component of quality, it should be associated with a shorter time to E-5 promotion. Figure 1.1 makes this comparison. It plots the percentage of E-4s who have been promoted to E-5 against the number of months in E-4. Personnel are divided on quality, where the high-quality group contains members who have a high school diploma and score in the upper half of the AFQT score distribution, and the low-quality group contains the remainder.[3] Personnel are further grouped into "fast" or "slow" to E-4—i.e., shorter or longer than the median

[1]This discussion draws from unpublished 1998 RAND work by Lee Lillard and Rebecca Kilburn on "Ability and Sequential Schooling Choices." Standard scores have a mean of 50 and standard deviation of 10. Prior to 1989, the AFQT score equaled the sum of the raw scores on Word Knowledge, Paragraph Comprehension, and Arithmetic Reasoning, and one-half that on Numerical Operations.

[2]Lillard and Kilburn also cite studies by Karpinos (1966) and Eitelberg et al. (1984) to this effect.

[3]In 1995 the percentages of recruits who were high-quality were as follows: Army, 64 percent; Navy, 60; Marine Corps, 62, and Air Force, 82. The percentages for 1988 were 59, 52, 64, and 81, respectively (*Population Representation*, 1996).

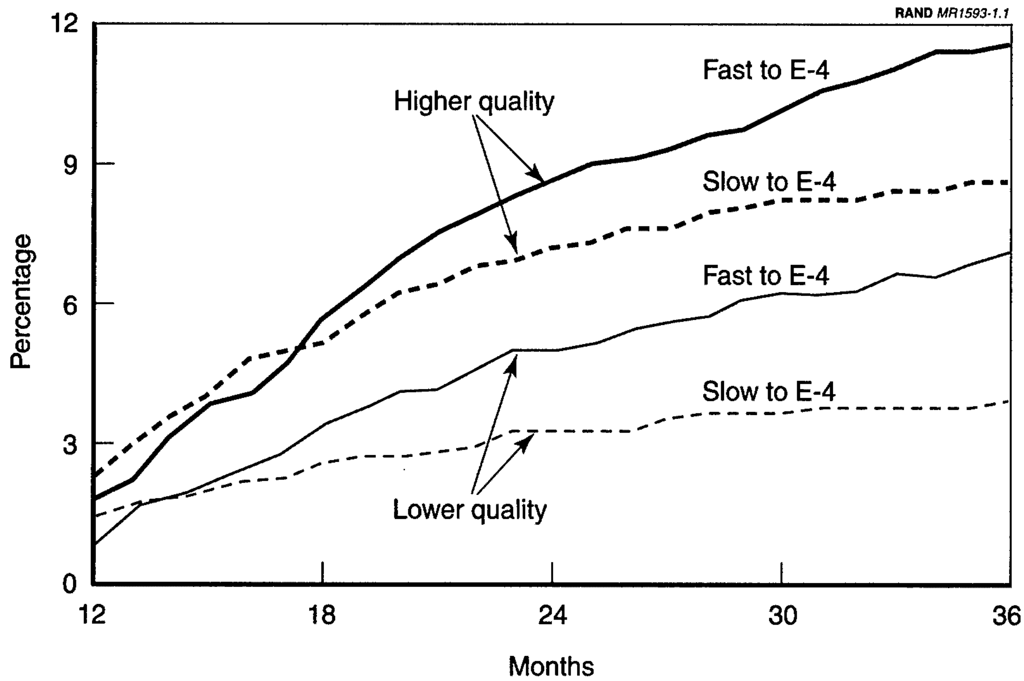

Figure 1.1—Cumulative Percentage Promoted to E-5 by Speed to E-4, 1988 Army Cohort

time of those in their entering cohort who reached E-4. As seen, high-quality personnel are promoted to E-5 sooner than low-quality personnel. More to the point, holding quality constant, those promoted fast to E-4 are also promoted fast to E-5. Ward and Tan found a similar relationship in their 1974 data. This relationship implies that additional information about quality is revealed on the job and is reflected in relative time to promotion.

GUIDE TO THE FOLLOWING CHAPTERS

Chapter Two discusses Gibbons and Waldman's work on internal labor markets and the use of output data to learn about a worker's quality. It also reviews studies of military promotion and presents charts of promotion patterns in the services. Chapter Three compares the military context to that of a large private organization, arguing further that military promotion data contain information about a member's quality. This chapter also presents Ward and Tan's model of quality and discusses how to apply it to estimate a member's quality. Chapters Four and Five describe our econometric application of the model and report estimates of model parameters. Chapter Five also provides estimates of the proportion of variance in overall quality that comes from variation in the component of quality estimated through promotions, i.e., through the quality of job match as opposed to AFQT score. Chapter Six presents our conclusions. Appendix A discusses standardization and comparison of the quality measure across cohorts, occupations, and services, Appendix B gives detailed analysis tables supporting the findings in Chapter Five, and Appendix C presents the estimated parameters for 334 models over 14 cohorts.

Chapter Two

PREVIOUS STUDIES AND PERSONNEL QUALITY INDICATORS

In this chapter, we review literature from two areas of study: (1) the wage and promotion dynamics of internal labor markets, where we concentrate on the paper by Gibbons and Waldman (1999), and (2) promotion in the military. Gibbons and Waldman (hereafter, GW) argued that the process of learning about worker ability must be a part of any model capable of explaining the features of wage change and promotion observed in internal labor markets. Although findings in empirical work were the motivation for their model, none of the studies they survey produces estimates of the importance of learning about ability. Our analysis of military promotions produces such estimates, although—unlike GW—we interpret our results as reflecting the quality of job match between the member and the service rather than "ability." Because we analyze military data, we survey a number of studies of military promotion. However, with the exception of Ward and Tan (1985), these studies did not estimate learning about quality.

We also present charts on military promotion. The charts illustrate how promotion speed differs by military service, by cohort, by occupation, and by AFQT, though much less so by HSDG. The lack of a relationship to HSDG occurs because most enlisted personnel are high school graduates, making it difficult to observe much difference between HSDG and non-HSDG personnel. The fact that promotion speed differs by service, cohort, and occupation means that in applying a model that depends on a member's promotion speed relative to the promotion speed of peers, we should group the data by service, cohort, and occupation. Our model includes AFQT as an explanatory variable.

INTERNAL LABOR MARKETS

Gibbons and Waldman summarized the findings of empirical research on internal labor markets. They identified Baker, Gibbs, and Holmstrom (1994a,b) (hereafter, BGH) as the most comprehensive empirical assessment of wage and promotion outcomes in internal labor markets in private organizations. Because the findings in BGH are consistent with the findings of other empirical studies that are narrower in scope, GW focused their discussion on BGH. BGH found the following:

- Real wage decreases occur infrequently, and demotions are rare.
- A worker's wage increases are serially correlated, as are promotion speeds.

- A worker who receives a large wage increase early at one level of a job ladder tends to be promoted more quickly to the next.
- A worker promoted from one level of a job ladder to the next is likely to come from the top of the lower job's wage distribution and likely to enter the bottom of the upper job's wage distribution.

GW sought to determine what features enable a theory of the wage and promotion dynamics of internal labor markets to generate a range of implications consistent with the empirical patterns documented in BGH. GW proved that, in the context of a large organization with an internal labor market characterized by a job ladder, three features can make such a theory of job assignment possible:

- assignment based on effective ability
- human capital acquisition
- symmetric learning about worker ability.

More specifically, GW developed a model in which workers have innate ability, effective ability, and an individually observable output that depends on the assigned job and the worker's effective ability. In this model, the process of learning about ability can be described as follows. Each person is assumed to be of either high innate ability θ^h or low innate ability θ^l. High innate ability occurs with probability p_0 and low innate ability occurs with probability $(1-p_0)$. The effective ability η_{it} of person i at time t depends on innate ability and prior experience: $\eta_{it} = \theta_i f(x_{it})$.[1] Experience, denoted by x_{it}, represents the acquisition of human capital. The person's output is a function of the job characteristics, the person's effective ability, and a random factor: $y_{ijt} = d_j + c_j(\eta_{it} + \varepsilon_{ijt})$. Here, d_j and c_j reflect job characteristics, and the job ladder is such that higher-rank jobs have lower intercepts d_j and higher returns c_j to effective ability. The random term is assumed to be normally distributed $N(0,\sigma^2)$ and independent of effective ability. The signal about the worker's effective ability in period t is $z_{it} = (y_{ijt} - d_j)/c_j = \eta_{it} + \varepsilon_{ijt}$. GW referred to this signal as normalized output; z_{it} adjusts the worker's observed output for the effect of job characteristics d_j and c_j. More generally, we see that the firm is assumed to be able to abstract from the characteristics of the job and perceive the "filtered" signal $\eta_{it} + \varepsilon_{ijt}$. Learning about the worker's ability is assumed to be symmetric in the sense that all firms can observe the worker's normalized output and competitively bid for the worker's services once the signal is observed. The worker's wage can change from period to period as a result of the bidding; to retain a worker, a firm must adjust its wage to meet the bids of other firms. Although in practice other firms would typically not be able to observe the signal of the worker's output, the worker would have an incentive to spread that information to the other firms. The incentive comes from knowing these firms would bid for the worker's services. Since the worker's own firm knows

[1] GW did not model effort, but presumably effort affects the effective amount of experience accumulated per unit of time. Since GW measured experience only by the passage of time, differences in effort will be reflected as differences in "ability" in their model.

the worker can do this, the firm has an incentive to pay the worker enough to avoid losing the worker to the other firms.

Although firms do not know a worker's innate ability, they can estimate the probability that the worker has high innate ability from signals on the worker's effective ability. Following GW, let z^x represent the signals received in the previous x periods, and let $p(\theta=\theta^h \mid z^x)$ be the probability that the worker has high innate ability given z^x. By Bayes' Theorem, the posterior probability of high innate ability given the next signal z_{it} is

$$p(\theta=\theta_{it}^h \mid z^x, z_{it}) = \frac{p(\theta=\theta^h \mid z^x) h(z_{it} - \theta^h f(x_{it}))}{p(\theta=\theta^h \mid z^x) h(z_{it} - \theta^h f(x_{it})) + (1 - p(\theta=\theta^h \mid z^x)) h(z_{it} - \theta^l f(x_{it}))}$$

where h is the density of ε_{ijt}, i.e., $N(0,\sigma^2)$. As seen, the value of ε_{ijt} that enters the density in this calculation depends on whether the worker is high-ability or low-ability. For instance, if the worker is high-ability, then $\varepsilon_{ijt} = z_{it} - \theta^h f(x_{it})$. The term $p(\theta=\theta^h \mid z^x)$ is the estimate after x periods of the probability that the worker is high-ability; the initial value of this probability is p_0. If the likelihood $h(z_{it} - \theta^h f(x_{it}))$ is greater than the likelihood $h(z_{it} - \theta^l f(x_{it}))$, then $p(\theta=\theta^h \mid z^x, z_{it})$ will be greater than $p(\theta=\theta^h \mid z^x)$.

The posterior probability can be used to compute the worker's *expected* innate ability at the end of t, i.e., as of the beginning of $t+1$:

$$\theta_{it}^e = p(\theta=\theta^h \mid z^x, z_{it})\theta^h + (1 - p(\theta=\theta^h \mid z^x, z_{it}))\theta^l.$$

The worker's expected innate ability will vary from period to period as new signals are received. Depending on the sign and size of the new signal, expected innate ability will increase or decrease.

Expected effective ability changes from one period to the next because of changes in experience and changes in expected innate ability. This follows since $\eta_{it}^e = \theta_{it}^e f(x_{it})$. The added experience (human capital acquisition) affects expected effective ability through $f(x_{it})$, and this effect is always positive. However, the change in θ_{it}^e can be positive or negative.

By including learning about ability in their model, GW could account for demotions. If ability were known, effective ability would always increase as experience increased. As a result, demotions would not occur, a worker's wage would always rise over time, and both wages and promotions would be serially correlated. By assuming that ability is not known but must be inferred from a noisy signal, the model allows for wage decreases and demotions. Although wages tend to rise because of experience, a decrease in expected innate ability could be large enough to offset the effect of experience and could cause the wage to decrease. A large enough decrease in expected innate ability could cause a demotion. Further, BGH reported slower wage increases on average after promotion than before promotion; such a finding can be rationalized

with learning about ability.[2] Some workers of lower innate ability who have had a period of exceptionally high output will be included among the promotees. This effect also weakens the serial correlation in wage increases and promotions, though such correlation remains possible.

MILITARY STUDIES OF PROMOTION

We located several analyses of promotion speed in the military: Daula and Nord (1985), Smith, Sylwester, and Villa (1991), and Buddin, Levy, Hanley, and Waldman (1992). None of the studies was designed to learn about service member quality through promotions.[3]

Daula and Nord and Smith et al. employed hazard models to analyze the time to promotion in the Army. Daula and Nord studied the times to E-5 and E-6 promotion for eight military occupational specialties in 1980–1984. Smith et al. analyzed promotion to E-4, E-5, and E-6 for three broad occupational areas—infantry, mechanics, and administration—for personnel entering service from 1974 to 1984. The studies differ somewhat in their explanatory variables and hazard functions,[4] but both studies found statistically significant negative effects of AFQT and years of education on the log of promotion time to E-5 and E-6. That is, higher AFQT scores and more education reduced the time to promotion, as expected. Smith et al. found negative education effects for promotion to E-4, but the effects of AFQT were zero in these regressions. Both studies treated promotion to each grade separately, not as joint outcomes. The studies did not attempt to identify a latent component of quality that acts persistently on time to promotion.

The studies entered the time to previous promotion as an explanatory variable in the models, which might be problematic. If a person's promotion time is affected by an unobserved component of quality, then the use of time to previous promotion can cause a simultaneity bias. The coefficient on the time to previous promotion would be biased upward; lower-quality persons would tend to have longer times to previous and current promotions. For instance, when Smith et al. estimated their model with promotion times adjusted for minimum time in grade, they found, as expected, a positive effect of time to previous promotion on time to current promotion.[5] In con-

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[2]In our view, other mechanisms could cause slower wage increases after promotion than before promotion. One mechanism is an increase in the variance of ε when the worker learns the ropes of the new position, and another is an increase in uncertainty about the mean and variance of ε. Uncertainty could increase if newly promoted workers affect the efficiency of their work group.

[3]In addition, the studies did not directly validate measures of personnel quality as measures of job performance. For a review of military studies that related AFQT, education, experience, and unit turbulence to productivity, see Asch and Warner (1994).

[4]Daula and Nord assumed that the time to promotion has a Weibull distribution, and Smith et al. assumed that the log of time to promotion has a normal distribution.

[5]When promotion times were not adjusted for minimum time in grade in their study, a faster previous promotion resulted in a slightly *longer* time to current promotion. For instance, a half-year faster promotion to E-4 in the infantry produced a 0.6 percent increase in time to E-5, or approximately one week. The authors attributed this to minimum time-in-service (TIS) requirements. Their data were primarily from the mid- to late-1970s, when retention was declining and promotion speeds were fast. Hence, TIS re-

trast, Daula and Nord found that a shorter time to the previous promotion was associated with a slightly longer time to the current promotion.

In their study of promotion tempo and reenlistment, Buddin et al. estimated a model of promotion speed in which the log of time to E-5 promotion is normally distributed. They hypothesized that a member with a shorter expected time to E-5 had higher expected future military earnings and therefore was more likely to reenlist. They estimated a two-equation model, and their estimates supported their hypothesis. Their data consisted of males who entered the Army and Air Force in fiscal years 1983–1989 and completed a four-year term of service. They defined promotion time as months in service at promotion (not months in grade, as did Daula and Nord and Smith et al.). They, too, found that a higher AFQT score shortened promotion time, not having a high school degree lengthened it, and postsecondary education shortened it (relative to HSDG status).

Contrary to Daula and Nord but consistent with Smith et al., Buddin et al. found that a longer time to E-4 resulted in a longer time to E-5.[6] The cohorts they analyzed entered the military in the mid-1980s, an era of higher retention and longer times to promotion than the late 1970s and early 1980s. As a result, few of their observations were constrained by time-in-service requirements. In their initial specification for the Army, a 1-percent increase in the number of months to E-4 led to a 1.7- percent increase in months to E-5. Adding more promotion information—time to E-4 promotable, not yet E-4 promotable (i.e., not having met the minimum requirements for promotion), and E-5 promotion point score—reduced the impact of months to E-4 to a 1.1-percent increase. In other words, because a 1-percent increase in months to E-4 caused about a 1-percent increase in total months to E-5, no information came from the months-to-E-4 variable. Instead, the added promotion variables provided the explanatory power. But because time to E-5 depends directly on promotability and promotion points, we think this was to be expected. When data on promotability and promotion points are lacking, the results suggest the time to E-4 promotion serves as a surrogate.

PERSONNEL QUALITY INDICATORS

Figures 2.1–2.3 show the cumulative percentage promoted to E-5 by months in E-4. These figures illustrate that because months to E-5 vary significantly by service, cohort, and occupation, those factors should be controlled in multivariate analyses. As seen, the percentage promoted increases with time in grade but does not reach 100 percent—and rarely exceeds 50 percent—because many personnel reaching E-4

quirements would have been a binding constraint on more personnel in the 1970s than they were in the early 1980s and later.

[6]Figure 1.1 shows that faster promotion to E-4 leads to faster promotion to E-5, holding AFQT and education constant. This accords with Smith et al. and Buddin et al. and GW, but not with Daula and Nord.

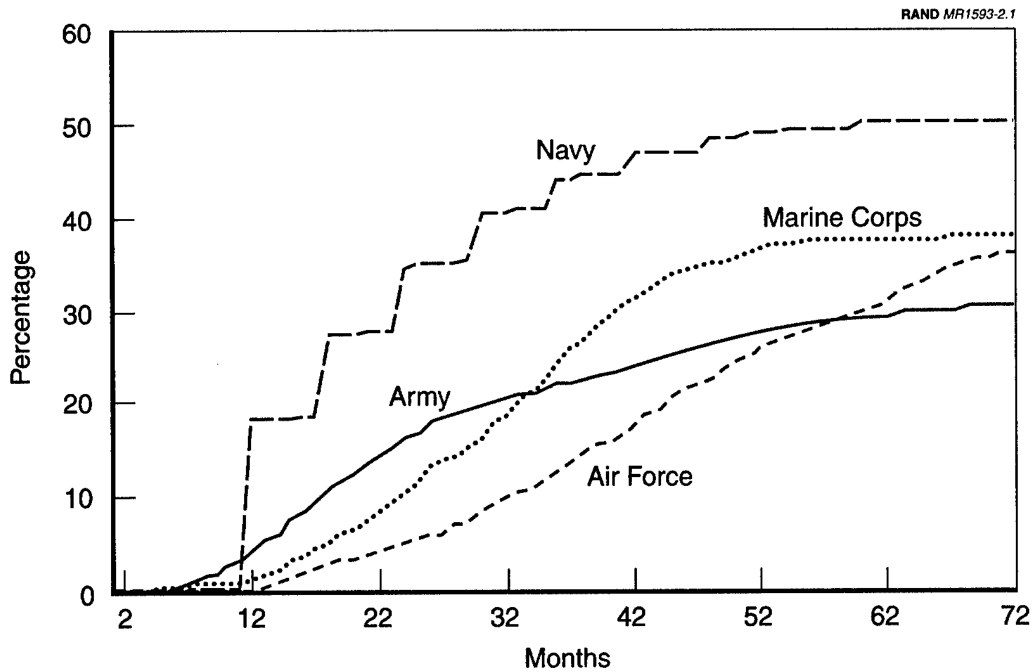

Figure 2.1—Cumulative Percentage Promoted to E-5 by Months in E-4, 1984 Cohort

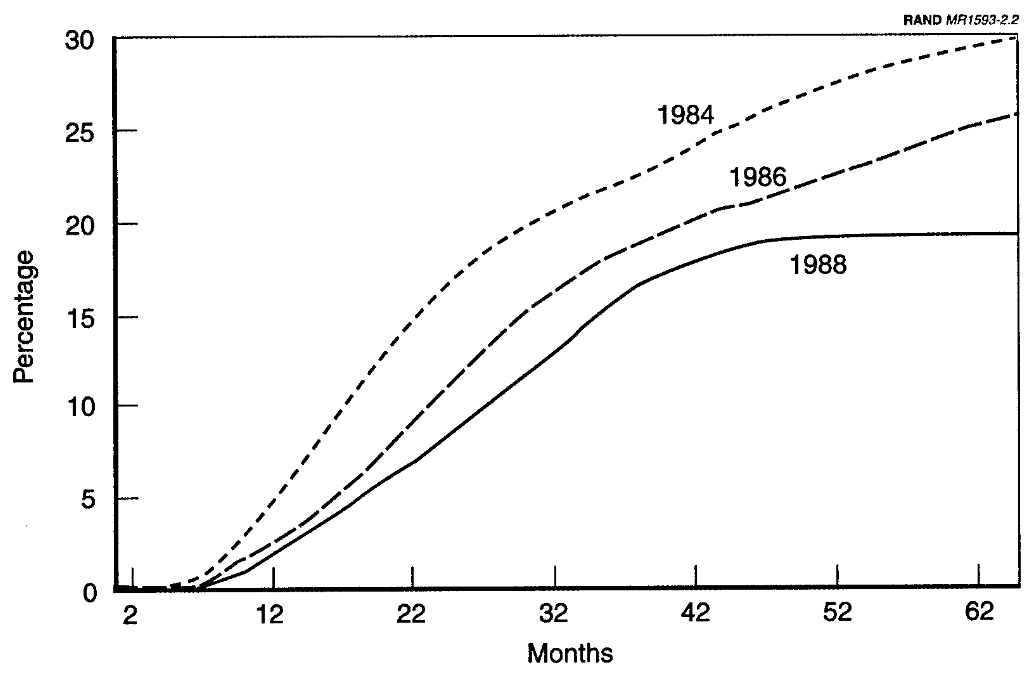

Figure 2.2—Cumulative Percentage Promoted to E-5 by Months in E-4, Army

either do not complete their term of service or do not reenlist and so are not available for promotion.[7]

The Navy promoted the 1984 cohort most rapidly, whereas the Air Force promoted most slowly over much of the range (Figure 2.1). Reaching E-5 took one-third less time in the Navy than the Air Force, with the Army and Marine Corps lying in between. In the Army, promotion times were longer for the 1986 and 1988 cohorts than for the 1984 cohort (Figure 2.2). Promotion to E-5 took about 50 percent longer for the 1988 cohort.

Focusing on the 1984 Army cohort, we found differences in promotion tempo across the occupations[8] of infantry, communications and intelligence, functional support, and service support (Figure 2.3). The promotion tempos in functional support and service support were nearly double those in the infantry, with communications and intelligence in between. Similar patterns occurred in the other services.

Figure 2.4 depicts average AFQT scores among promotees to E-5 by months in E-4 until promotion, for the 1984 Army and Air Force cohorts. Air Force promotees had higher average AFQT scores than did Army promotees, but both services had nearly

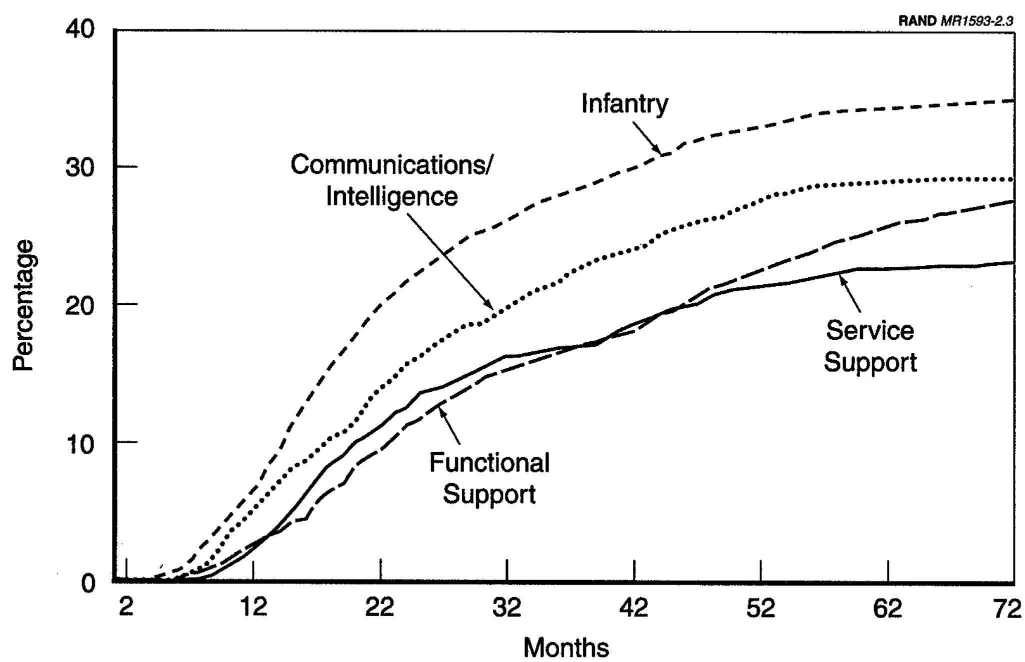

Figure 2.3—Cumulative Percentage Promoted to E-5 by Months in E-4 and Occupation, 1984 Army Cohort

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[7]Some personnel are eventually affected by up-or-out criteria that stipulate a maximum time in grade. Although we do not have data on the percentage of personnel who reach the maximum time in grade and must leave, it is probably quite small (perhaps 1 percent).

[8]These are one-digit DoD occupation codes that include many three-digit occupations.

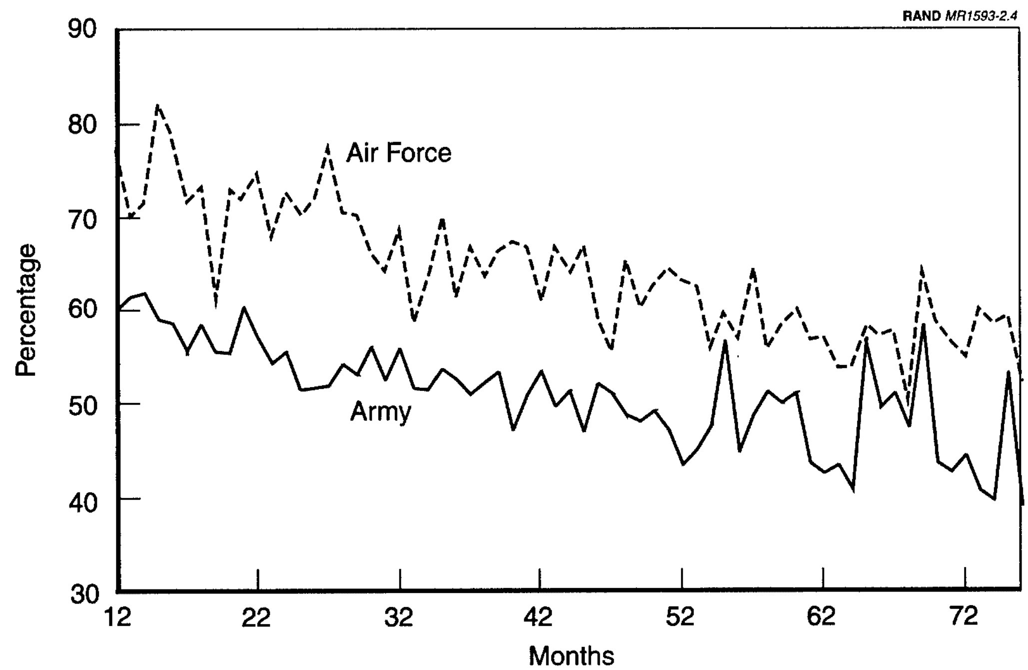

Figure 2.4—Average AFQT by Months to E-5, 1984 Army and Air Force Cohorts

identical patterns of decline in average scores as time to promotion lengthened. The figure supports the interpretation of AFQT as an indicator of personnel quality.

Figures 2.5 and 2.6 illustrate similar relationships at the one-digit occupation level. Here, average AFQT scores decline as months to promotion increase for infantry and service support, and for communications/intelligence and functional support. The figures suggest some flattening in this relationship for the highest categories of months in E-4. That is, the average AFQT score is about the same over these months. Also, the increased variation at higher months reflects smaller samples (fewer promoted) in those months.

We found a decline in the percentage of promotees who were high school graduates as months to promotion increased, but there was virtually no relationship for the Air Force (Figure 2.7). Nearly all Air Force recruits were HSDGs—99 percent in the 1984 cohort versus 86 percent in the Army.[9] As a result, there was little opportunity for the percentage of promotees who were HSDGs to decline as months to promotion increased. For Army communications/intelligence and infantry specialties, the percentage of promotees who were HSDGs declined as months to promotion rose (Figure 2.8). There was larger month-to-month variation because cohort sizes were smaller in particular specialties.

[9]In 1995, HSDGs were 94 percent of Army recruits, 93 percent of Navy, 95 percent of Marine Corps, and 99 percent of Air Force. (*Population Representation*, 1996.)

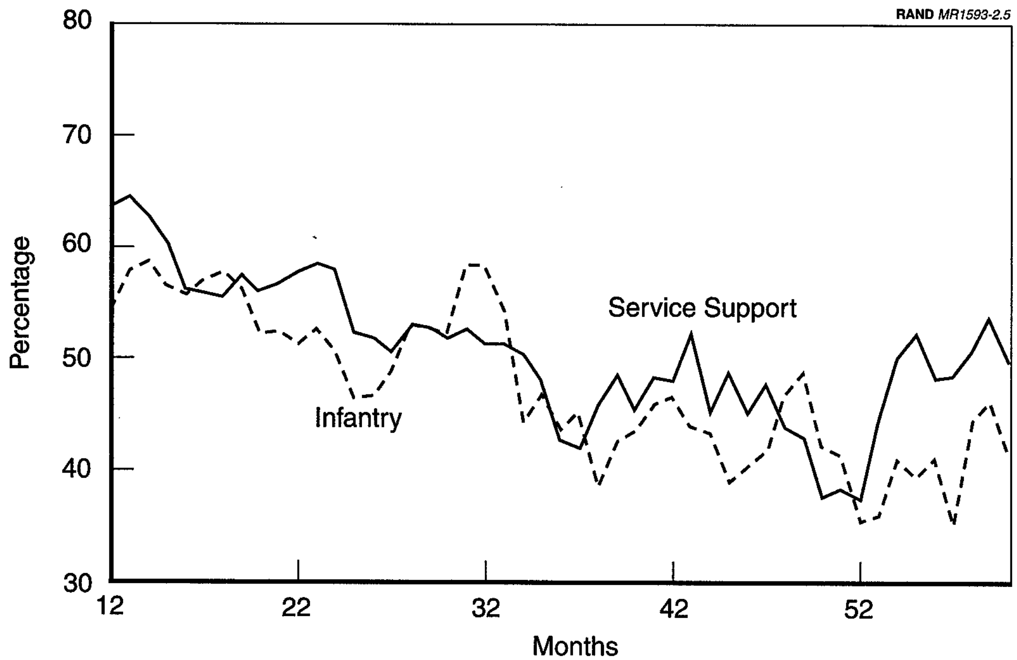

Figure 2.5—Average AFQT by Months to E-5 and Occupation, 1984 Army Cohort (Panel A)

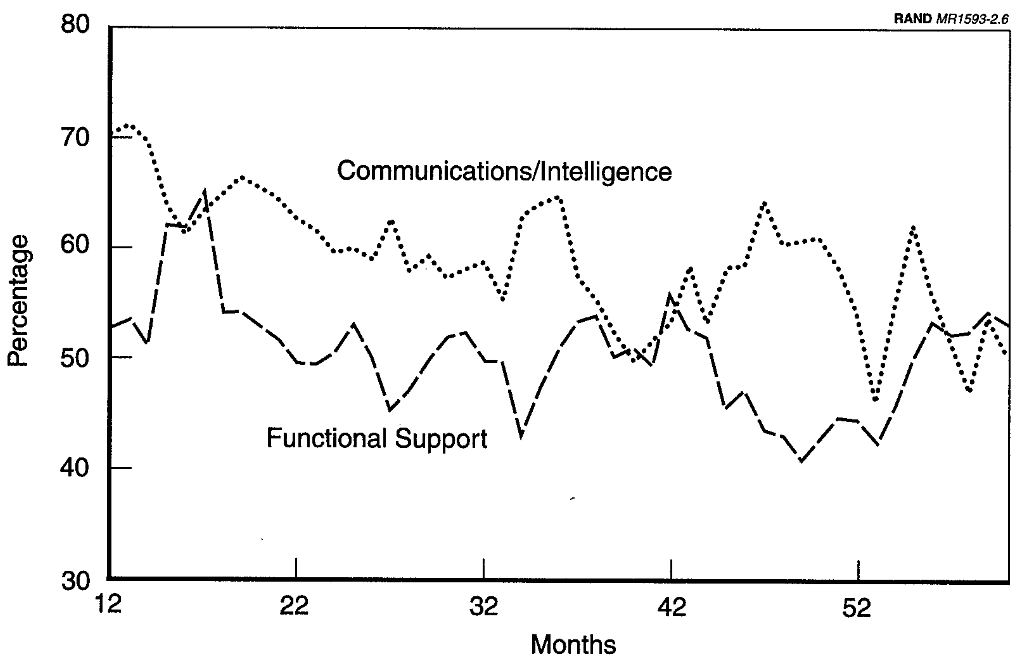

Figure 2.6—Average AFQT by Months to E-5 and Occupation, 1984 Army Cohort (Panel B)

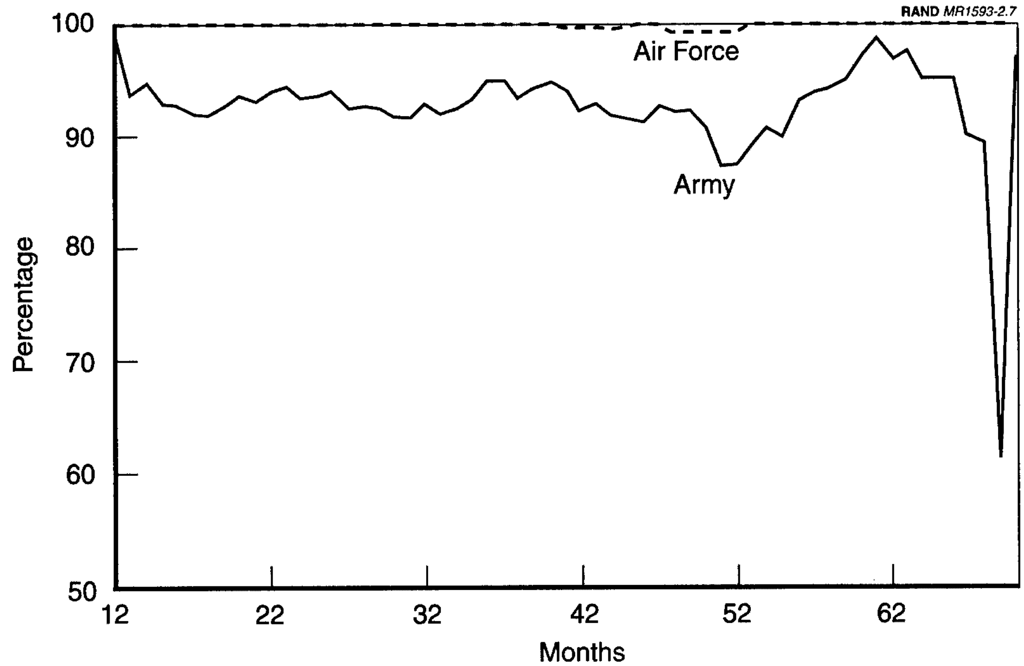

Figure 2.7—Percentage HSDGs by Months to E-5, 1984 Army and Air Force Cohorts

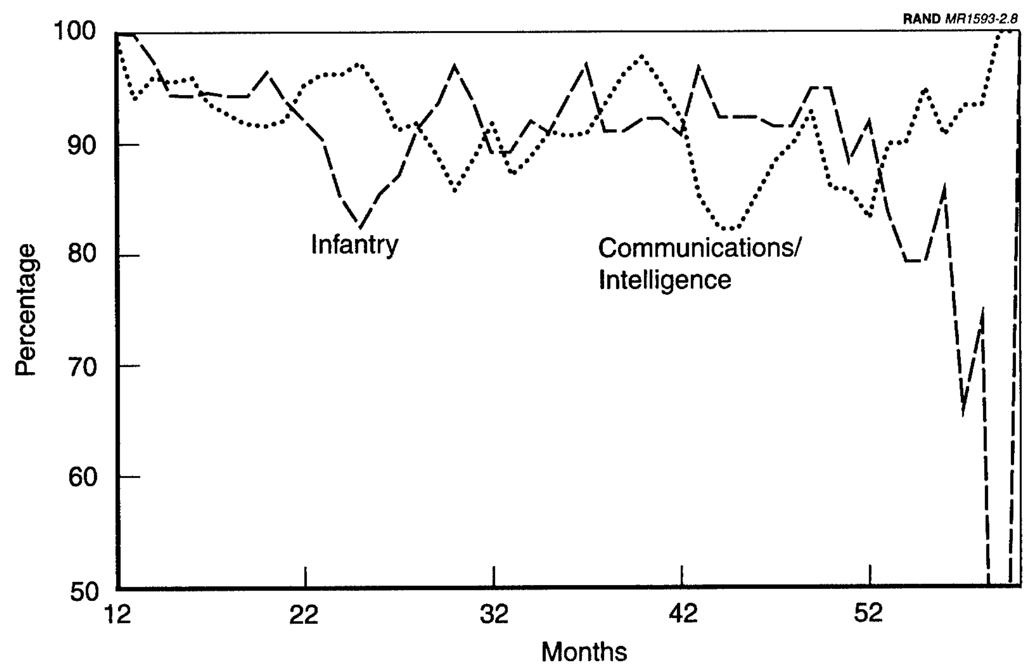

Figure 2.8—Percentage HSDGs by Months to E-5 and Occupation, 1984 Army Cohort

In sum, the figures imply that empirical models of military promotion should control for service, cohort, occupation, and AFQT. However, there is little explanatory power in HSDG when a high fraction of recruits are high school graduates, as has been the case since the early 1980s.

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Chapter Three

A BAYESIAN MODEL OF SERVICE MEMBER QUALITY

In this chapter, we discuss the similarities and differences between the internal labor markets in the military and in private organizations, as described by the findings in BGH. The discussion explains why military data on promotions are suitable for estimating a model of learning about worker ability, even though the military pays personnel according to a pay table and does not make year-to-year pay changes on the basis of individual performance evaluations. We then discuss Ward and Tan's model of quality and describe how to estimate an individual's unobserved component of quality.

THE MILITARY CONTEXT

Gibbons and Waldman outline an approach to learning about quality, which they refer to as *innate ability*. Their model makes two assumptions that are difficult to satisfy in empirical work: Individual output is observed in each period, and a normalized signal of effective ability can be obtained. We know of no data on large organizations that meet these requirements; the data in the widely cited BGH study do not. Although output is readily observable for piece-rate workers, they are typically not part of a job hierarchy. Workers in job hierarchies often work in teams, making it difficult to determine an individual's output even when team output is observed. The relationship between a worker's effective ability and his or her output may not be the two-parameter linear relationship assumed in GW; hence, it is not obvious how to extract a normalized output signal.

The military shares some of these limitations. For instance, military personnel are assigned to units and almost always work in teams. Unit or team output is usually not measured or recorded, and the relationship between an individual's effective ability and his or her output, if measured, may not be linear. However, the military, like other organizations, wants to assign personnel efficiently, and the military has an explicit hierarchy of ranks. Movement up the ranks requires promotion.

Retaining and motivating high-quality personnel poses a problem for the military given its common table of basic pay. Since basic pay is the same for everyone in a particular rank and year of service, the military must rely on tools such as reenlistment bonuses and promotions to compete with outside opportunities, which may vary by occupation and individual quality. Bonuses are allocated to military occupations on the basis of a perceived critical shortage of personnel and do not depend on

a member's performance. That is, bonus allocation is neutral with respect to quality. For instance, reenlistment bonuses do not depend on a member's AFQT score or education level. In contrast, the promotion process is meant to identify superior performers and reward them with advancement to higher rank and an accompanying increase in pay. The promotion system is the chief means of assessing, recognizing, and rewarding quality.

For this mechanism to be effective, the promotion system must distinguish between high- and low-quality personnel, where quality depends not only on attributes such as AFQT score but also on having the skills and knowledge required for mission-essential tasks and capably performing assigned duties. Therefore, the service has a significant stake in assuring a well-functioning promotion system because the cost of a poorly functioning promotion system is a weaker organization.

Each service has an explicit promotion system (see Williamson, 1999). These promotion systems have been stable over time. Promotion depends on specific performance evaluation criteria. The promotion system assigns points based on the enlistee's performance on current assignment, knowledge, skills, physical fitness, awards and decorations, education, and potential for performance in higher-rank positions. Higher-rank positions generally require more knowledge, skills, experience, and leadership ability. The pace of promotion depends on a member's promotion points relative to others in the promotion pool, and on the service's requirements for advancing personnel to the next rank (i.e., the demand). Thus, the promotion system assesses quality on the basis of current and prospective value to the organization. Higher-quality members can expect faster promotions and higher military lifetime compensation. They might also obtain superior assignments. As a result, promotion speed appears to be a valid indicator of the quality of the match between the member and the military.

We do not want to exaggerate the potential of the promotion system for studying personnel quality, however. In this study, we assume that promotion speed is an indicator of the quality of the job match, and for the reasons described we think this assumption is reasonable. But we have not undertaken a separate study to validate the relationship between promotion speed and objective measures of job performance. In addition, we have not found any validation studies in the literature. Therefore, our approach and findings should be seen as conditional on this assumption.

Fortunately for analysis, the military recruits large cohorts of youth who enter particular military specialties in statistically useful numbers. Enlistees in a specialty receive the same formal training and have similar patterns of duty assignments, tasks, and career development opportunities. Therefore, they have the same opportunity to build their human capital and demonstrate their prowess.

How does the military's internal market compare with those in private organizations? Table 3.1 summarizes the similarities and differences. A military member's year-to-year pay changes result from adjustments to basic pay, longevity increases in pay in the same rank, and promotions to a higher rank. Adjustments to basic pay are usually across-the-board, although occasionally certain pay cells receive higher increases. Longevity increases depend strictly on longevity in the service, whereas promotions

Table 3.1

Wage and Promotion Dynamics: Private Organizations Versus the Military

Private Organizations[a]	Military
Real wage decreases occur infrequently.	Real basic pay increase was below CPI in 10 of the 17 years from 1981 to 1998. However, a service member's pay growth also depends on promotion and longevity increases. Overall, real wage decreases are infrequent.
Demotions are rare.	Same
Wage increases are serially correlated.	Within a rank, the basic pay table dictates wage increases.
Promotion speeds are serially correlated.	Same
On average, workers who receive a large wage increase early at one level of a job ladder are promoted more quickly to the next.	Wage movement within a rank follows the basic pay table. But as shown in Figure 1.1, members promoted fast to E-4 also tend to be promoted fast to E-5.
Individuals promoted from one level of a job ladder to the next come disproportionately from the top of the lower job's wage distribution and go disproportionately into the bottom of the upper job's wage distribution.	Promotion points tend to accumulate with experience and longevity wage increases occur, so those promoted tend to come from the top of the lower job's wage distribution. They tend to enter the bottom of the next rank's wage distribution. However, members who accumulate promotion points most rapidly might be nearer the middle of the wage distribution in their rank when they are promoted.

[a]As summarized in Gibbons and Waldman (1999).

depend on output and effort. Therefore, the military system reveals information about a person's quality through promotions and promotion speed, but not through wage changes within a rank. In contrast, internal labor markets in private organizations reveal information about quality also through wage changes within a job.

WARD-TAN MODEL

Holding entry quality constant, Figure 1.1 showed that members who were promoted more rapidly to E-4 were also promoted more rapidly to E-5. This suggests the presence of an unobserved quality factor, and the Ward-Tan model provides a means of incorporating this additional information about quality. Following Goldberger's (1972) multiple-indicator, multiple-cause model, Ward and Tan assume that quality is *indicated* through promotion speed and *caused* by certain variables observed at entry and by a member-specific component of quality (or *quality factor*).

Ward and Tan used AFQT score and education as the entry characteristics.[1] The quality factor represents other characteristics persistently bearing on performance and hence affecting promotion speed to E-4 and E-5. Holding constant the entry characteristics, the quality factor causes a correlation in promotion times: members

[1]Unlike Ward and Tan, we do not use education in our analysis. This is because nearly all enlistees in our data are HSDGs.

who are promoted more rapidly to E-4 can expect to be promoted more rapidly to E-5.

Once the model has been estimated, the promotion times to E-4 and E-5 can be used to compute the expected value of the member's quality factor and quality, as described below. The model allows us to distinguish the extent to which fast promotions reflect unobserved quality rather than randomness. Also, the quality function, when estimated, shows the weights that should be placed on AFQT and education relative to the unobserved quality factor. Thus, the model solves the problem of how to combine several indicators of quality into a single quality index. Moreover, as we show, it provides a basis for updating the estimate of the service member's quality, i.e., for learning about quality. Information about quality is extracted by continually comparing the member's promotion status to that of peers.

The quality model has three equations.[2] The first equation relates the member's quality to his or her entry characteristics and quality factor:

$$q_i = \beta x_i + \varepsilon_i \ .$$

Although q_i and ε_i are not observed, the model's parameters β can be estimated through the effect of quality on promotion times, and a posterior estimate of the expected value of the quality factor can be obtained. The entry characteristics x_i are measured as differences from their means. As a result, the quality equation does not have an intercept. The quality factor ε_i is assumed to be normally distributed with zero mean and unit variance, $N(0,1)$, and we write the normal density as $\phi(\varepsilon_i)$. Thus, each member has a given quality factor, unknown to the military and the analyst, who know only that *any* particular value of the quality factor imputed to the member occurs with a probability described by the standard normal density. Quality is measured in units of standard deviation. We can see this by considering the average person ($x_i = 0$). Then $q_i = \varepsilon_i$, and since ε_i is $N(0,1)$, the standard deviation of quality is the standard deviation of the quality factor, which is 1.

The second and third equations define the member's promotion time to E-4 and E-5 as a function of quality. This relationship can be expressed in different ways that can be translated from one to the other. It can be written in terms of a promotion-hazard function, which describes the probability of promotion at time t given that promotion has not occurred prior to t. It can be written as a promotion-distribution function, which describes the probability that promotion occurs at or before t, or as a promotion-density function, which indicates the likelihood of promotion occurring at t. We use promotion-hazard functions to estimate the model, but for our immediate purposes it is convenient to use the promotion-density function. We write the promotion densities as

[2]Here, we assume that the model's parameters are known in order to explain the model's structure and usefulness. We discuss estimation in the next chapter.

$$p(t_{4i}\,|\,q_i;\theta_4)$$
$$p(t_{5i}\,|\,q_i;\theta_5).$$

Here, $p(t_{4i}\,|\,q_i;\theta_4)$ is the probability density of the member's time to E-4 promotion conditional on the member's quality q_i and given parameters θ_4, and similarly for E-5 promotion.

We focus on the first term of service. During the term, either the member is promoted (e.g., promotion to E-4 occurs at t_{4i}) or the member has not yet been promoted as of the last observation on the member. In the latter case, the promotion outcome is *censored*. Censoring occurs if the member departs because of attrition or reaches the end of the term before being promoted.

Quality can cause a positive correlation between the promotion times to E-4 and E-5 because entry characteristics like AFQT affect promotion speed and because the quality factor affects promotion speed. Because quality has been defined to be a function only of entry characteristics and the quality factor, there are no other factors to cause a correlation between promotion times. Hence, the promotion probabilities conditional on quality are independent.

EXPECTED QUALITY

One approach to computing expected quality would be to take the expectation of the quality equation based on the prior distribution of ε_i, which is $N(0,1)$:

$$\begin{aligned} Eq_i &= E(\beta x_i + \varepsilon_i) \\ &= \beta x_i + E(\varepsilon_i) \\ &= \beta x_i. \end{aligned}$$

This approach is deficient because it ignores information about quality revealed through promotion.

To incorporate that information, we need the density of quality conditional on entry characteristics and promotion times:

$$p(q_i\,|\,t_{4i},t_{5i},x_i;\theta_4,\theta_5,\beta)\ .$$

This is a Bayesian posterior density, where the parameters β relate entry characteristics to quality and the parameters θ_4 and θ_5 relate quality to the E-4 and E-5 outcomes.

The posterior density for q_i is proportional to the product of the prior distribution of q_i, and the likelihood of the promotion times given q_i, the data, and the parameters. We assume that the prior distribution of q_i is that q_i is distributed as $N(\beta x_i,1)$, and we use $\pi(q_i)$ to denote this density:

$$p(q_i \,|\, .) \propto p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \pi(q_i)$$

where the "." in $p(q_i \,|\, .)$ denotes all the parameters and data except for q_i.

To obtain a proper density, we divide this expression by a normalizing constant as follows:

$$p(q_i \,|\, .) = \frac{p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \pi(q_i)}{\int_{-\infty}^{\infty} p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \pi(q_i) dq_i}.$$

The expected value of quality is then:

$$\begin{aligned} Eq_i &= \int_{-\infty}^{\infty} q_i p(q_i \,|\, .) dq_i \\ &= \int_{-\infty}^{\infty} q_i \frac{p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \pi(q_i)}{\int_{-\infty}^{\infty} p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \pi(q_i) dq_i} dq_i. \end{aligned}$$

With promotion taken into account, expected quality no longer equals only the effect of entry characteristics but also includes a term related to the quality factor:

$$\begin{aligned} Eq_i &= \int_{-\infty}^{\infty} q_i p(q_i \,|\, .) dq_i \\ &= \int_{-\infty}^{\infty} (\beta x_i + \varepsilon_i) p(\beta x_i + \varepsilon_i \,|\, .) d(\beta x_i + \varepsilon_i) \\ &= \beta x_i + \int_{-\infty}^{\infty} \varepsilon_i p(\varepsilon_i \,|\, .) d\varepsilon_i. \end{aligned}$$

The first line is the definition of expected quality, where the probability of observing a particular level of quality is now conditioned on the posterior quality density, which incorporates information about promotion outcomes as well as entry characteristics. The second line recognizes the fact that quality consists of two parts, one for entry characteristics and the other for the quality factor. The third line uses the fact that, with β and x_i known, βx_i is a constant for the individual and therefore can be brought outside the integral and also eliminated from the expression for dq_i.

Hence, expected quality has two parts. The first part reflects entry characteristics and equals the expected value of quality when the expected value of the quality factor is zero. The second part is the expected value of the member's quality factor computed under the posterior density.

As with q_i, the posterior density for ε_i is proportional to the product of the prior distribution of ε_i, and the likelihood of the promotion times given ε_i, the data, and the rest of the parameters:

$$p(\varepsilon_i \,|\, .) \propto p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i).$$

To get the density we divide by a normalizing constant:

$$p(\varepsilon_i \,|\, .) = \frac{p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i)}{\int_{-\infty}^{\infty} p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i) d\varepsilon_i}.$$

Thus, the expected value of a member's quality can be expressed as

$$\begin{aligned} Eq_i &= \beta x_i + \int_{-\infty}^{\infty} \varepsilon_i p(\varepsilon_i \,|\, .) d\varepsilon_i \\ &= \beta x_i + \int_{-\infty}^{\infty} \varepsilon_i \frac{p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i)}{\int_{-\infty}^{\infty} p(t_{4i} \,|\, q_i;\theta_4) p(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i) d\varepsilon_i} d\varepsilon_i. \end{aligned}$$

Expected quality depends on the member's entry-level characteristics and the expected quality factor. The portion related to entry characteristics does not change through time. The portion related to the quality factor changes as information about promotion outcomes is updated.

BAYESIAN UPDATING AND LIMITS ON INFORMATION ABOUT QUALITY

Estimating an individual's quality can be seen as a process of Bayesian updating. Making this connection places the process in a familiar framework and helps illustrate how information about a person's quality accumulates over time and ceases to accumulate when the person departs from service. Because βx_i does not change over time, updating focuses on the expected value of the quality factor ε_i. In our case, the posterior density of the quality factor at $t+1$ is:

$$p_{t+1}(\varepsilon_i \,|\, t_{4i}, t_{5i}; x_i, \theta_4, \theta_5, \beta) = \frac{p_t(t_{4i} \,|\, q_i;\theta_4) p_t(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i)}{\int_{-\infty}^{\infty} p_t(t_{4i} \,|\, q_i;\theta_4) p_t(t_{5i} \,|\, q_i;\theta_5) \phi(\varepsilon_i) d\varepsilon_i}.$$

Several points follow from this expression. First, at the outset of a military career, no promotions have occurred and expected quality equals βx_i only, as shown above. Also, the probability that promotion will occur in the future is 1:

$$p_0(t_{4i} > 0 | q_i; \theta_4) = 1.$$
$$p_0(t_{5i} > 0 | q_i; \theta_5) = 1.$$

Substituting this into the formula for the posterior density, we have

$$p_1(\varepsilon_i | t_{4i}, t_{5i}; x_i, \theta_4, \theta_5, \beta) = \frac{\phi(\varepsilon_i)}{\int_{-\infty}^{\infty} \phi(\varepsilon_i) d\varepsilon_i} = \phi(\varepsilon_i).$$

This equation implies that at the outset the posterior density of the quality factor equals the prior density. Thus, the posterior density can be seen as "growing out" of the prior density. The second equality follows because the integral of the denominator is the integral over the normal density, which equals 1. Applying this result, the a priori expected value of ε_i is 0:

$$E(\varepsilon_i) = \int_{-\infty}^{\infty} \varepsilon_i \phi(\varepsilon_i) d\varepsilon_i = 0.$$

Second, suppose the service member leaves at the end of period T. The last posterior density for this person will be

$$p_{T+1}(\varepsilon_i | t_{4i}, t_{5i}; x_i, \theta_4, \theta_5, \beta) = \frac{p_T(t_{4i} | q_i; \theta_4) p_T(t_{5i} | q_i; \theta_5) \phi(\varepsilon_i)}{\int_{-\infty}^{\infty} p_T(t_{4i} | q_i; \theta_4) p_T(t_{5i} | q_i; \theta_5) \phi(\varepsilon_i) d\varepsilon_i}.$$

No future updates will be possible; the date of leaving service places an upper limit on what can be known about the person's quality. Even though other personnel continue, we cannot learn about this person's ability from the future promotions of continuing personnel. The posterior density normalizes the member's likelihood as of T, not with respect to future posterior densities for which no new observations on the member will be available. For the same reason, the member's expected quality factor at T is not comparable with that of other members at a later date—i.e., members who continue and who therefore have more time during which promotion can occur. However, the quality of the member leaving at T can be compared with that of members continuing at T.

ILLUSTRATION OF BAYESIAN UPDATING

Figure 3.1 illustrates how quality changes over time for three members. Each member has the same entry characteristics, which are equal to the average entry characteristics for their cohort. But the members differ in their quality factor. One member has a high quality factor, the second member has a medium quality factor, and the

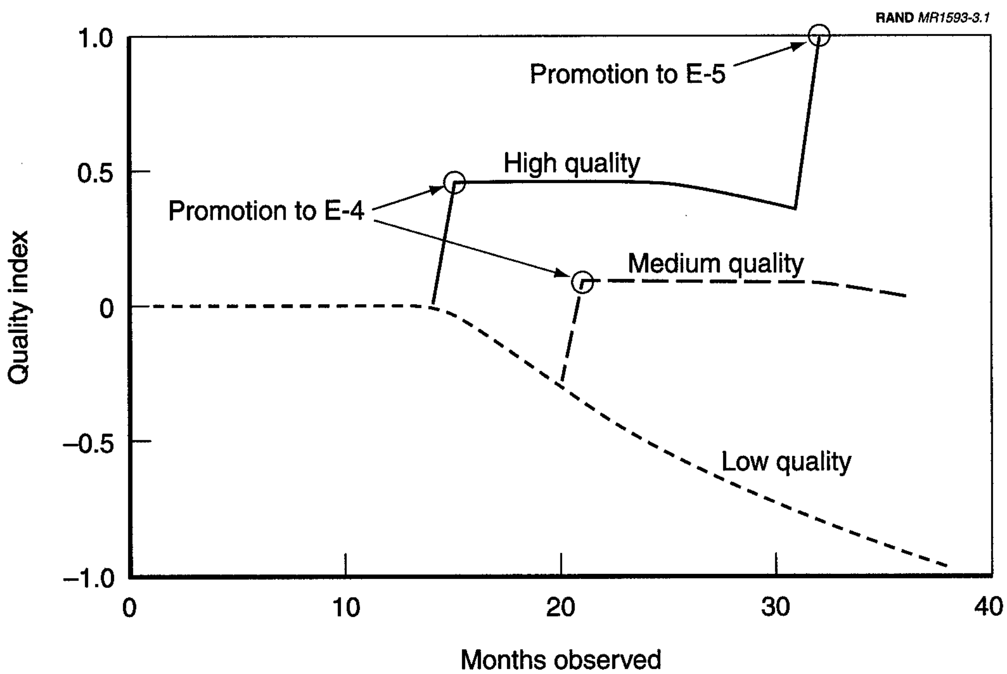

Figure 3.1—Quality Index Is Updated As New Information Is Revealed Over Time

third member has a low quality factor. The figure plots each member's quality against the number of months the member is observed.

Initially, quality has the value of 0 for all three members.[3] The amount of information on quality increases when promotion occurs. Information increases because the exact time of promotion tells the promotion density specifically where to locate a member as expected quality is computed. By comparison, if promotion has not yet occurred, the promotion outcome term is the probability that promotion occurs *later than T*. Given the effect of entry characteristics βx_i, a fast promotion time locates the person such that the expected quality factor is high, while a slow promotion time leads to a low value. As shown, promotion to E-4 occurs soonest for the member with the high quality factor. When this occurs, the expected value of the member's quality rises. But because the other members have not yet been promoted, their expected quality begins to decline. Their promotion progress tends to be slower than that of their peers.

The medium-quality member is promoted next, increasing the member's expected quality. This quality is estimated to be lower than that of the high-quality member but higher than that of the low-quality member, as one would expect. The expected quality of the low-quality member, who is never promoted, continually declines. The high-quality member receives a second promotion, to E-5, and his expected quality

[3]This is because their entry characteristics are average, so the value of x_i is 0, and because the expected value of the quality factor at the time of entry is 0.

increases further. However, in the months prior to this promotion, his expected quality declined slightly, reflecting the fact that other members of his cohort were beginning to be promoted to E-5.

When a member's promotion observations are censored early in the promotion process, at a time when only a small percentage of the cohort has been promoted, knowledge of the member's promotion timing is quite limited. We know only that promotion would occur at a later date, but not whether promotion would occur earlier or later *than expected,* given the member's entry characteristics. As a result, the expected value of the quality factor ε_i tends to be near 0, and most of the information about quality comes from βx_i, the a priori expected quality. The expected value of ε_i tends to be near 0 because the probability of being promoted at a later date is near 1. When that is true, the posterior density of ε_i approximately equals the prior density of ε_i, and—as we have seen—the expected value of ε_i is 0 under the prior density. By implication, if a large fraction of personnel have not been promoted to E-5 by the end of the first term, their quality estimates will not be fully informative about their quality factor. Almost all of the information about quality will have come from the entry characteristics and E-4 promotion outcome.

This completes our presentation of the Bayesian model of member quality based on entry characteristics and promotions. We next discuss the implementation of the model.

Chapter Four

MODEL IMPLEMENTATION

In this chapter we first give an informal, intuitive explanation of how the model is implemented and then present a more precise mathematical characterization. Readers mainly interested in the policy implications of the work may safely skip the mathematical exposition.

HOW THE MODEL WORKS: BASIC INTUITION

The model works in two steps:

Step 1: Estimate a statistical relationship between AFQT, unobserved quality, and promotion speed to E-4 and E-5 for a group of enlistees.

Step 2: Use estimates from Step 1 and individual AFQT and promotion speed to E-4 and E-5 to estimate individual quality.

In the first step, we use the population in a particular service, cohort, and occupation to estimate a model relating promotion to quality for the population. Then we use the model to calculate the probability of particular promotion outcomes for an individual, given the individual's AFQT and quality factor, to calculate the expected value of the individual's quality index. (We think of it as using the estimated relationship to "handicap" individuals for their observable characteristics; when we see how people perform relative to their handicap we get information about the unobserved component of quality.)

Details of Step 1

The quality index is composed of directly observable components, like AFQT and education, and an indirectly observable component, the individual quality of job match, or "quality factor." Figure 4.1 shows how these components fit into the overall quality index.

As Figure 4.1 indicates, the overall quality index, q, in turn affects the speed of promotion to E-4 and to E-5. So quality is "indicated" by promotion speed to E-4 and E-5, and is "caused" by AFQT and an unobservable quality factor. (This is why this kind of model is referred to as a "Multiple-Indicator Multiple-Cause" (or "MIMIC") model.)

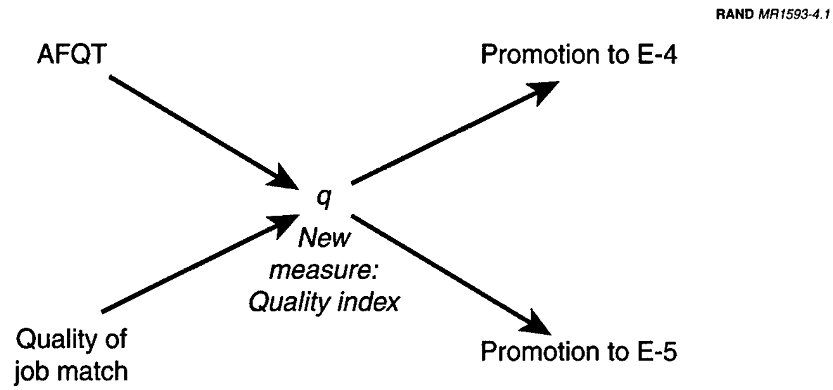

Figure 4.1—Quality Is Indicated by Promotion Speed and "Caused" by Observable and Unobservable Components

Measuring speed of promotion is not as straightforward as it seems, because we do not always directly observe how long it takes someone to be promoted. While nearly everyone gets promoted to E-4 in the first term, only a fraction of enlistees get promoted to E-5.[1] However, even if we do not observe individuals being promoted to E-5 we still obtain some information by observing how many months they were in E-4 *without* being promoted to E-5.

This is what motivates us to model time to promotion probabilistically. We observe either that a person gets promoted at a particular time, with some probability, or that a person has *not* been promoted by the end of the first term, with some probability. We can model time to promotion as either a "survival curve" or as a "hazard curve."

Figure 4.2 shows a survival curve[2] and the corresponding hazard curve[3] for promotion to E-4. Time is on the horizontal axis in both graphs. In the survival curve graph on the left, the vertical axis gives the cumulative fraction of the population promoted to E-4 by a given month. So, for example, about 50 percent have been promoted to E-4 by the 20th month of service. The vertical axis can also be interpreted as the cumulative probability of promotion. So by the 20th month the cumulative probability would be 0.5.

---

[1]Unfortunately we cannot use information on time to promotion if the promotion occurs after the first term because this may lead to "selection bias." If the people who are more likely to be promoted quickly are also more likely to stay, then promotion time averages based on those people would underestimate the average time to promotion for the entire population of enlistees. Another possible example of selection bias is the many stories of drowning sailors being rescued by dolphins who herd them to shore. Unfortunately we never hear from those sailors who may have been herded further out to sea by dolphins.

[2]Strictly speaking, the graph shows 1 minus the survival curve. An orthodox survival curve would show how many people "survive" in E-1 to E-3 before they "succumb" to being promoted to E-4.

[3]It may seem a bit odd to refer to a "hazard" of promotion. The terminology we are using came originally from the medical statistics literature, where models like these are used to study when people fall ill or die from a disease. So "hazard" is merely a term of art and is not meant to imply that promotion is indeed hazardous!

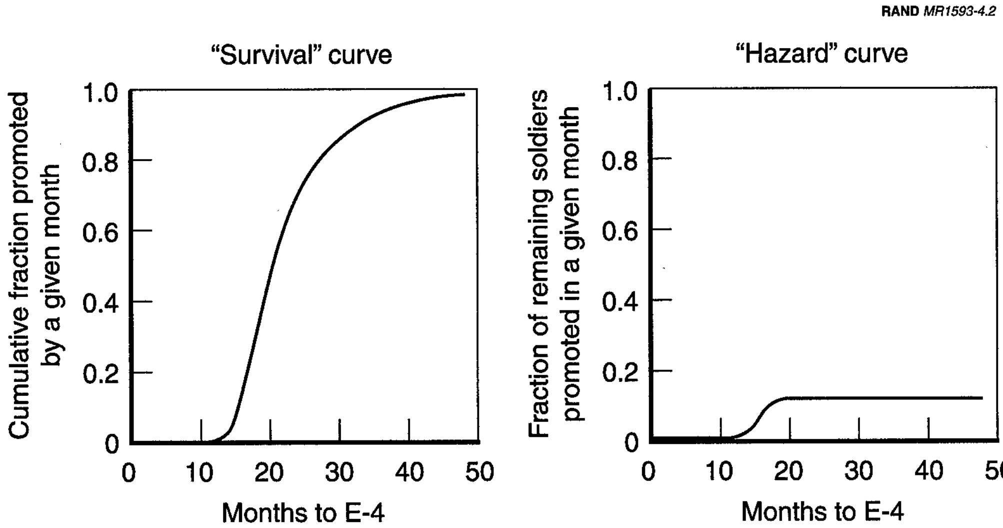

Figure 4.2—Survival Curves and Hazard Curves: Alternative Ways of Visualizing the Same Underlying Process

The right-hand side of Figure 4.2 shows the hazard curve. It depicts exactly the same process as the survival curve, but in a slightly different way. The vertical axis shows the probability that an individual will be promoted in a particular month, given that the person has not been promoted before that month. In this example, up until the 10th month the hazard rate is 0, meaning that there is no probability that a person will be promoted to E-4 (perhaps due to time-in-grade or time-in-service requirements). Over the next few months, the probability climbs until it tops out at about 13 percent, meaning that from about the 20th month on, the probability of being promoted in a particular month (given that one has not been promoted so far) is 13 percent.

In our model, we use hazard curves to model the process of promotion, but this is just a mathematical nicety. We could just as well have used survival curves.[4]

Quality influences the time to promotion. We model this influence by using the quality index to shift the hazard of promotion up or down, as in Figure 4.3. If the hazard is shifted up, at any point in time the probability of being promoted (given that promotion has not already occurred) is greater; if the hazard is shifted down, the probability of being promoted (given that promotion has not already occurred) is less.[5]

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[4]We explored an alternative formulation that used a cumulative normal survival curve derived from a "Tobit-like" model where the dependent variable was time to promotion. This formulation did not fit the data as well as the original Ward-Tan hazard curve approach. The time-to-promotion Tobits, when translated into hazard functions, implied that quality shifted the hazard function left or right. By comparison, in the proportional hazard model used by Ward and Tan, quality shifted the hazard function up or down.

[5]This would correspond to the survival curve moving left or right. If the survival curve moves left, the cumulative probability of being promoted at any given point in time rises, while if it moves right the cumulative probability of being promoted at any given point in time declines.

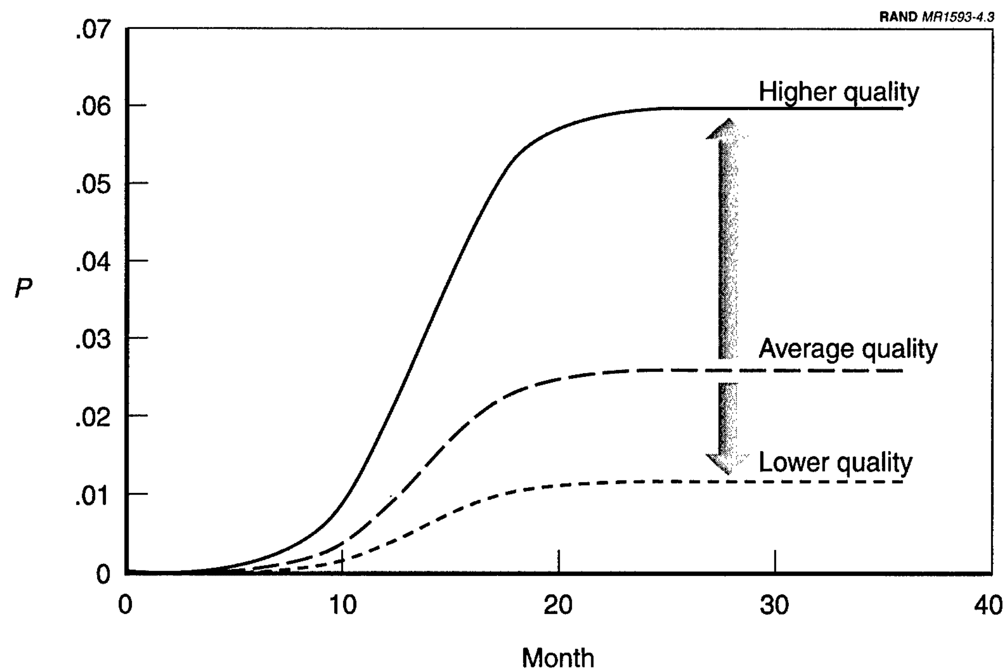

Figure 4.3—Quality Shifts the Hazard of Promotion

If we have the parameters of the baseline hazard function, a "shift" parameter, and an individual's quality, we can calculate the probability that the individual is promoted in any given month. So, for any given individual, we can calculate the probability of observing his or her particular promotion timings and other observable characteristics. (Since we only directly observe part of the quality index, we calculate the expected value of the probability of promotion over all possible values of the unobserved component.) We combine the individual probabilities into a likelihood function, and choose the set of parameters that maximizes the likelihood function, that is, the set of parameters that maximizes the probability of observing the outcomes that we actually observed.

Details of Step 2

Once we have estimated the parameters of the promotion-timing model we can then estimate the expected value of the unobserved component of individual quality. We can think of it as using the estimated relationship to "handicap" individuals for their observable characteristics; when we see how people perform relative to their handicap, we get information about the unobserved component of quality.

But how can we distinguish someone who is simply lucky in being promoted early (perhaps due to the slip of a pen) from someone who was promoted early based solely on merit? We can use the information from two (or more) promotion times to distinguish the effect of quality from simple luck. By looking at the correlation of

promotion times across two or more promotions within a population, we can identify the random component and isolate the quality factor from simple random error.

HOW THE MODEL WORKS: A MORE FORMAL APPROACH

The model works in two steps:

Step 1: Estimate hazard functions for promotion to E-4 and E-5 as a function of baseline hazard parameters and a shift parameter that is a linear combination of AFQT and unobserved quality.

Step 2: Use estimates from Step 1 and observed promotion or exit times to calculate the expected value of unobserved quality.

Details of Step 1

We first discuss quality. Quality is a function of entry characteristics x_i and unobserved quality ε_i:

$$q_i = \beta x_i + \varepsilon_i.$$
$$\varepsilon_i \sim N(0,1).$$

The entry characteristics are measured in terms of deviations from their means, and the quality factor has a normal distribution with zero mean and unit variance.

Ward and Tan employ hazard functions to model the relationship between quality and promotion. Hazard functions allow us to follow a member over time, gathering observations from month to month on whether promotion has or has not occurred. Just as in the famous Sherlock Holmes case of the dog not barking, there is information about the relationship between quality and promotion from observations that promotion has *not* occurred by a given month. The capacity to incorporate information on non-promotion is valuable because many members either do not complete their first term or are not promoted to E-5 by the end of their first term. First-term attrition can be 30 percent or more, and many attritees do not reach E-4, let alone E-5. Also, promotions to E-5 rarely exceed 35 percent of E-4s by the end of the first term, and the percentage is far lower in the Air Force—around 5 to 10 percent.

Ward and Tan specify a proportional hazard model for time to promotion. This model defines the hazard—that is, the probability of promotion at time t given that promotion has not yet occurred—as the product of a baseline hazard and a quality effect that shifts the hazard up or down relative to the baseline. Figure 4.4 depicts the shape of the baseline hazard for typical values. The parameters determine the point of maximum inflection, the slope, and the asymptotic hazard of promotion.

The Ward-Tan promotion hazards for E-4 and E-5 are given by:

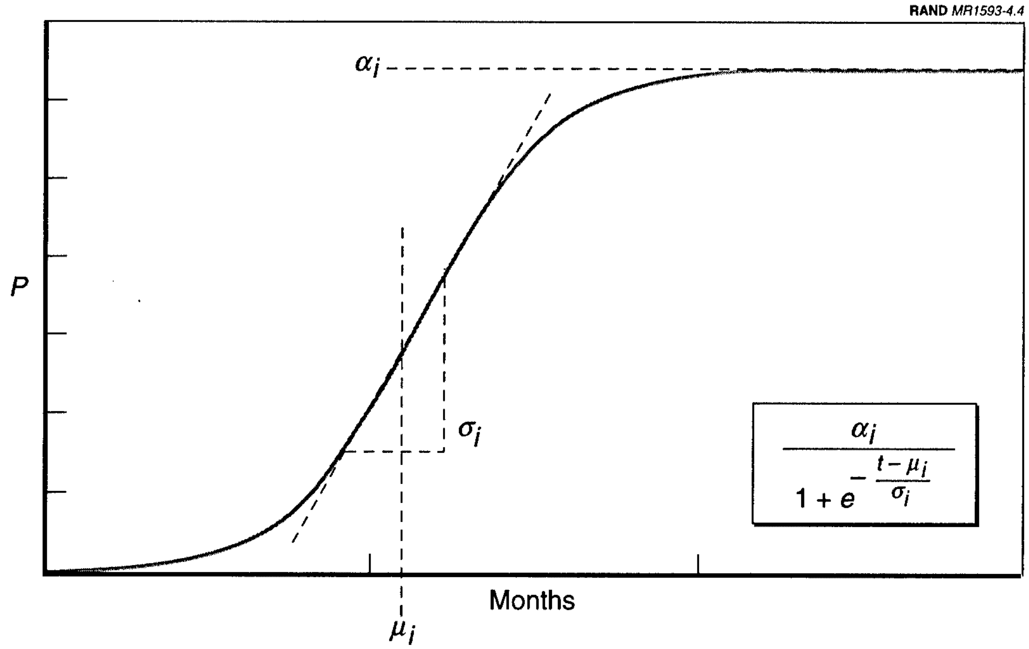

Figure 4.4—Parameterized Baseline Hazard Function

$$h_4(t;q_i) = \bar{\lambda}(\alpha_4,\mu_4,\sigma_4,t)e^{\gamma_4 q_i}$$
$$h_5(t;q_i) = \bar{\lambda}(\alpha_5,\mu_5,\sigma_5,t)e^{\gamma_5 q_i}$$
$$\bar{\lambda}(\alpha,\mu,\sigma,t) = \frac{\alpha}{1+e^{-\frac{t-\mu}{\sigma}}}$$

Here, $\bar{\lambda}(\alpha_j,\mu_j,\sigma_j,t)$ is the baseline hazard for promotion to grade *j*. The time indicator in the E-4 hazard measures time from entry into service; promotion times to the lower grades E-2 and E-3 are included in the cumulative time to E-4. Because promotions to E-2 and E-3 occur somewhat mechanically as the service member progresses through boot camp and occupational training, little information about quality is lost by not explicitly considering these promotions. The time indicator in the E-5 hazard measures time from the time of entry into E-4, i.e., the date of promotion to E-4.

A service member's quality affects the promotion hazard through the shifter terms $e^{\gamma_4 q_i}$ and $e^{\gamma_5 q_i}$. If a service member's quality is average (i.e., 0), then the value of the shifter is e^0 or 1, and the baseline hazard is unaffected. If the service member's quality is above average, then the exponent is greater than 0 and the shifter term will be greater than 1, resulting in an increase over the baseline hazard. Similarly, below-average quality will shift the hazard downward.

The logistic form of the baseline hazard reflects service policy on the promotion window (the period over which most promotions occur) and pace of promotion. The lo-

gistic shape allows the promotion hazard to be very low initially, to rise as the promotion window opens, and eventually to attain a constant value. For instance, the E-4 baseline hazard tends toward α_4 because as time increases the term in the denominator $e^{-(t-\mu_4)/\sigma_4}$ goes to 0. At high values of *t*, a person has nearly the same chance of promotion from one moment to the next, conditional on not having been promoted.[6]

The eventual, constant hazard seems contrary to common experience where, for a *group* of personnel, promotion hazard seems to rise and then decline. The rise signals that personnel have met their time-in-service and time-in-grade requirements and are promotable. For many, promotion occurs soon after, but for others the promotion process seems to drag on, indicating a decline in the promotion hazard. Ward and Tan attribute the decline not to a decline in the baseline hazard but to heterogeneity: as time increases, the promotion pool increasingly consists of lower-quality personnel because higher-quality personnel have already been promoted.

Assuming quality has a positive effect on the promotion hazards $(\gamma_4 > 0, \gamma_5 > 0)$, higher quality increases the member's promotion hazard and therefore the chance of having been promoted by any given time. Since higher quality increases the hazard rate, it follows that more high-quality personnel will have been promoted by *t*, compared with the number of lower-quality personnel promoted by then. The lower-quality personnel are less likely to be selected for promotion and so have a longer average time to promotion. For the same reason, their rate of outflow from the promotion pool is lower at any given time. Thus, quality heterogeneity among group members can be expected to produce first a *rising* hazard rate and later a *declining* hazard rate for the group.

To estimate the Ward-Tan model, the hazard rates are translated into promotion probabilities, which are used in a likelihood function. The parameters of the model are then estimated by maximum likelihood.

Promotion Outcome Probabilities

Deriving promotion probabilities from the hazard functions requires the fundamental relationships of hazard analysis, which we briefly present. Hazard analysis defines a *time-dependent* cumulative distribution function:

$$F(t;q) = P(\text{time of promotion} \le t;q) 0 < t < \infty.$$

The corresponding probability density is

$$f(t;q) = \frac{dF(t;q)}{dt}.$$

[6]In the range where the hazard approaches a constant value, a discrete hazard process becomes similar in effect to a first-order Markov process. In the latter, the probability of transitioning to another state (e.g., a higher grade) is constant from period to period and does not depend on prior states.

The instantaneous hazard at time *t* is

$$h(t;q) = \frac{f(t;q)}{1 - F(t;q)}.$$

If we solve this differential equation for $F(t;q)$, we can write the discrete probability of an event *not* happening in the interval *s* to *t* as

$$F(s;q) - F(t;q) = e^{-\int_s^t h(u;q)du}.$$

Using the above relationship, we can express the probability of observing promotion or non-promotion in terms of the hazard. To be more specific, recall that we had defined the continuous hazard of promotion as

$$\bar{\lambda}(\alpha,\mu,\sigma,t) = \frac{\alpha}{1 + e^{-\frac{t-\mu}{\sigma}}}.$$

Let us write the baseline probability of non-promotion in the interval *s* to *t* as

$$\lambda(\alpha,\mu,\sigma,s,t) = e^{-\int_s^t \bar{\lambda}(\alpha,\mu,\sigma,u)du}.$$

We can write the discrete probability of non-promotion of an individual with quality *q* in the interval *s* to *t* as

$$e^{-\int_s^t h(u;q)du} = e^{-\int_s^t \bar{\lambda}(\alpha,\mu,\sigma,u)e^{\gamma q}du} = \lambda(\alpha,\mu,\sigma,s,t)^{e^{\gamma q}}.$$

We then can write the probability that an individual with quality q_i is not promoted to E-4 by month T_4 as

$$\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma q_i}}.$$

We are not quite finished. Since we do not directly observe q_i, to construct a likelihood function we need to calculate the expectation of the above expression with respect to the distribution of the unobserved component of quality.[7] Recall that

$$q_i = \beta x_i + \varepsilon_i.$$
$$\varepsilon_i \sim N(0,1).$$

[7]This procedure is sometimes referred to as "integrating out unobserved heterogeneity."

Let $h(\cdot)$ be the standard normal density. Then the probability that an individual with observable characteristics x_i is not promoted to E-4 by month T_4 is

$$\int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma(\beta x_i+\varepsilon)}} h(\varepsilon)d\varepsilon.$$

The Likelihood Function

Using the above relationships, we express the four possible promotion outcomes for E-4 and E-5 in terms of the promotion hazards. The four outcomes are (1) not promoted to E-4, (2) promoted to E-4 and then immediately left, (3) promoted to E-4 and not promoted to E-5, and (4) promoted to E-4 and promoted to E-5. Each member's promotion outcomes in the first term can be expressed by one of the four types. Given the appropriate type, we enter the member's entry characteristics and promotion outcomes into the probability expression. Taking the product over the entire sample, we create the sample likelihood.

Here are the probabilities for the four possible outcomes:

(1) Probability of not being promoted to E-4 by month T_4:

$$P(E\!-\!4 \ > T_4;\theta) = \int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma_4(\beta x_i+\varepsilon)}}$$

where T_4 is the month of attrition or the end of the first term, whichever comes first, and $\theta = (\beta,\alpha_4,\mu_4,\sigma_4,\gamma_4,\alpha_5,\mu_5,\sigma_5,\gamma_5)$ is the parameter vector.

(2) Probability of being promoted to E-4 at month T_4, and then immediately leaving:

$$P(\text{E}\!-\!4 \ = T_4;\theta) = \int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma_4(\beta x_i+\varepsilon)}} (1-\lambda(\alpha_4,\mu_4,\sigma_4,T_4-1,T_4)^{e^{\gamma_4(\beta x_i+\varepsilon)}})h(\varepsilon)d\varepsilon$$

where the $\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma_4(\beta x_i+\varepsilon)}}$ term is the probability of not being promoted in the first T_4-1 months, and the $1-\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1,T_4)^{e^{\gamma_4(\beta x_i+\varepsilon)}}$ term is the probability of being promoted in the T_4th month.

(3) Probability of being promoted to E-4 at month T_4, and then not being promoted to E-5 by month T_5:

$$P(\text{E}-4 \ =T_4,\text{E}-5 \ >T_5;\theta)=$$
$$\int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma_4(\beta x_i+\varepsilon)}}(1-\lambda(\alpha_4,\mu_4,\sigma_4,T_4-1,T_4)^{e^{\gamma_4(\beta x_i+\varepsilon)}})$$
$$\lambda(\alpha_5,\mu_5,\sigma_5,0,T_5)^{e^{\gamma_5(\beta x_i+\varepsilon)}} h(\varepsilon)d\varepsilon$$

where T_5 is the month of attrition or the end of the first term, whichever comes first, and the $\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma_4(\beta x_i+\varepsilon)}}$ term is the probability of not being promoted to E-5 after T_5 months in E-4.

(4) Probability of being promoted to E-4 at month T_4 and then promoted to E-5 at month T_5:

$$P(\text{E}-4 \ =T_4,\text{E}-5 \ >T_5;\theta)=$$
$$\int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma_4(\beta x_i+\varepsilon)}}(1-\lambda(\alpha_4,\mu_4,\sigma_4,T_4-1,T_4)^{e^{\gamma_4(\beta x_i+\varepsilon)}})$$
$$\lambda(\alpha_5,\mu_5,\sigma_5,0,T_5)^{e^{\gamma_5(\beta x_i+\varepsilon)}} h(\varepsilon)d\varepsilon$$

where the $\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma_4(\beta x_i+\varepsilon)}}$ term is the probability of not being promoted in the first T_5-1 months, and the $1-\lambda(\alpha_4,\mu_4,\sigma_4,T_4-1,T_4)^{e^{\gamma_4(\beta x_i+\varepsilon)}}$ term is the probability of being promoted in the T_5th month.

The likelihood function is

$$L(\theta)=\prod_{i\in G_1} P(\text{E}-4 \ >T_{4,i};\theta)\prod_{i\in G_2} P(\text{E}-4 \ >T_{4,i};\theta)$$
$$\prod_{i\in G_3} P(\text{E}-4 \ =T_{4,i},\text{E}-5 \ >T_{5,i};\theta)\prod_{i\in G4} P(\text{E}-4 \ =T_{4,i}\text{E}-5 \ =T_{5,i};\theta)$$

where $i \in G_1$ denotes that observation i belongs to outcome category j, as defined above. Given the likelihood function we can estimate the vector of parameters θ using normal maximum likelihood techniques.

Details of Step 2

In the previous chapter we derived the following expression for expected quality:

$$Eq_i = \beta x_i + \int_{-\infty}^{\infty} \varepsilon_i p(\varepsilon_i \,|\, .)d\varepsilon_i.$$

Given parameter estimates from the above model we can compute $p(\varepsilon_i \,|.)$, the probability of observing ε_i conditional on the estimated parameters and promotion his-

tory for individual *i*. Given $p(\varepsilon_i\,|.)$ we can then compute expected quality for an individual.

For example, suppose that an individual left without being promoted to E-4. Then $p(\varepsilon_i\,|.)$ will be proportional to the individual contribution to the likelihood, or

$$p(\varepsilon_i\,|.) \propto \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma(\beta x_i+\varepsilon_i)}}.$$

Dividing by the appropriate integrating constant to get a proper probability distribution gives us

$$p(\varepsilon_i\,|.) = \frac{\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma(\beta x_i+\varepsilon_i)}}}{\int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma 4(\beta x_i+\delta)}}\,h(\delta)d\delta}.$$

Then the expected quality for that individual would be

$$Eq_i = \beta x_i + \int_{-\infty}^{\infty} \varepsilon_i \frac{\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma 4(\beta x_i+\varepsilon_i)}}}{\int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4)^{e^{\gamma 4(\beta x_i+\delta)}}\,h(\delta)d\delta} h(\varepsilon_i)d\varepsilon_i.$$

Similarly, for an individual who was promoted to E-4 and then immediately left,

$$Eq_i = \beta x_i +$$

$$\int_{-\infty}^{\infty} \varepsilon_i \frac{\lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma 4(\beta x_i+\varepsilon_i)}}(1-\lambda(\alpha_4,\mu_4,\sigma_4,T_4-1,T_4)^{e^{\gamma 4(\beta x_i+\varepsilon_i)}})}{\int_{-\infty}^{\infty} \lambda(\alpha_4,\mu_4,\sigma_4,0,T_4-1)^{e^{\gamma 4(\beta x_i+\delta)}}(1-\lambda(\alpha_4,\mu_4,\sigma_4,T_4-1,T_4)^{e^{\gamma 4(\beta x_i+\delta)}})h(\delta)d\delta} h(\varepsilon_i)d\varepsilon_i,$$

and so on for the remaining cases.

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Chapter Five

DATA AND EMPIRICAL RESULTS

In this chapter, we apply the model to three services and many cohorts and occupations. We first discuss the data we used for our analysis. Then we present a detailed look at the model for a particular service, cohort, and occupation before moving on to look across services, cohorts, and occupations. We show how the quality index can be used to test the hypothesis that the services have not had much success in retaining higher-quality personnel. We also show how the quality index provides evidence of sorting behavior by members when they choose whether to stay or separate. Members with a greater comparative advantage in the military tend to stay in the military, while those with a greater comparative advantage in the civilian world tend to leave.

THE DATA

We used longitudinal data provided by the Defense Manpower Data Center (DMDC). These data, called the DMDC Special Cohort Accession and Continuer (DSCAC) file, track—through FY 1996—the careers of active-duty enlisted personnel who entered active duty in a given fiscal year. Each fiscal year entry group defines an entry cohort. Our analysis file includes entry cohorts from FY 1978 through FY 1992. For each cohort, the DSCAC data provide entry information (from the Military Entrance Processing Command), loss information, and either quarterly or semiannual information on each individual's active-duty career. The entry information includes AFQT score, ASVAB component scores, education at entry, race and ethnicity, occupation, age, and gender. The loss information, if relevant, includes occupation, marital and dependents status, education, and type of separation. The active-duty information includes occupation, education, pay grade, promotion date to current grade, and marital and dependents status.

We created several variables using the information provided in the DSCAC files. First, for each cohort we created variables indicating the number of months it took for an individual to be promoted to each grade. If the individual was not promoted to a given grade, variables were created that indicated this was the case. These "time to promotion" variables were used to estimate the quality index. Second, we created an attrition variable indicating whether an individual left before the completion of the enlistment term. Third, we created variables to indicate whether an individual reenlisted, extended, or left at the end of the first term. These variables can be used to

analyze how personnel quality varies among individuals at entry; among those who leave before the end of their first term versus those who continue; and among those who reenlist, extend, or leave at the end of their first term.

We excluded prior-service personnel from our analysis. Prior-service personnel account for 5 to 10 percent of all accessions. These individuals are excluded because their promotion times, attrition, or reenlistment behavior and their quality might be affected by their prior-service status. Insofar as the fraction of personnel who enter with prior service varies over time, analysis of quality and personnel outcomes may be affected by inclusion of prior-service personnel. We therefore excluded them.

Much of our analysis was conducted at the level of cohort entry year, service, and occupational area. We used the three-digit occupational codes to ensure that all individuals in a given occupation grouping were comparable. However, the estimation technique requires a minimum sample size that may be larger than the number of members in a given three-digit occupation in a particular service for a particular year. Thus, not all three-digit occupations are represented in the results. Sometimes the model could be estimated for some years and not for others; we present only those results where the model could be estimated.

EMPIRICAL RESULTS

We first present the estimates for a particular service, cohort, and occupation, showing in detail the implications of the estimates. Then we show results for all occupations for the Army, Air Force, and Marine Corps. We conclude with a discussion of how the Navy's promotion policy creates difficulties for our estimation procedure, and we examine a related policy implication for Navy personnel management.

A Detailed Look at One Service, Cohort, and Occupation

A detailed look at a single instance will help concretize the concepts covered in the theoretical discussion, building intuition and understanding for when we look across services, cohorts, and occupations. The following discussion owes much to the empirical analysis in the original Ward-Tan report and confirms the results Ward and Tan obtained for eight selected occupations across four services in the 1974 cohort.

Our occupation, service, and cohort example is the artillery and gunnery occupation (DoD occupation code 041) for the Army's FY 1978 cohort. We chose this example because it is a representative occupation for one of the key Army missions and because of the large sample size (2,500) and the relatively high percentage of soldiers who reached E-5 in the first term (18 percent). The findings below, though, are typical for other services, cohorts, and occupations, as will be seen in the following section.

Of the 2,500 soldiers in the sample, 74 percent were promoted to E-4 before the end of the first term, and of those promoted to E-4, 25 percent were promoted on to E-5. For the 74 percent promoted to E-4 before the end of the first term, the mean time to

E-4 was 21 months, with a standard deviation of 5 months. For the 25 percent promoted to E-5, the mean time to E-5 was 18 months, also with a standard deviation of 5 months.

Figures 5.1 and 5.2 show the Kaplan-Meier "survival curve" estimates for promotion to E-4 and E-5, respectively. The Kaplan-Meier estimates take into account the information revealed by observations that were censored before promotion to E-4 or to E-5, and so paint a more nuanced picture than the raw percentage in the previous paragraph. The figures show that, in time, nearly everyone will be promoted to E-4, and that most are promoted within a fairly narrow window of ten months. Promotion to E-5, however, is a bit more stringent, and the gentler slope of the estimated survival curve reflects a wider variance in time to E-5.

We divided the sample into four groups, by whether individuals were faster or slower than the mean time to E-4, and by whether they were above or below the mean AFQT for the sample. Figure 5.3 gives Kaplan-Meier survival curves for promotion to E-5 for these four groups. It shows that time to E-4 seems to play a much more important role in determining the speed of promotion to E-5 than does AFQT. This leads us to the hypothesis that entry characteristics, such as AFQT, may only account for a small part of the total quality of job match as revealed through promotion—a hypothesis we return to later.

Table 5.1 gives the parameter estimates for the model. All coefficients are significant at the 1-percent level and have the expected signs.

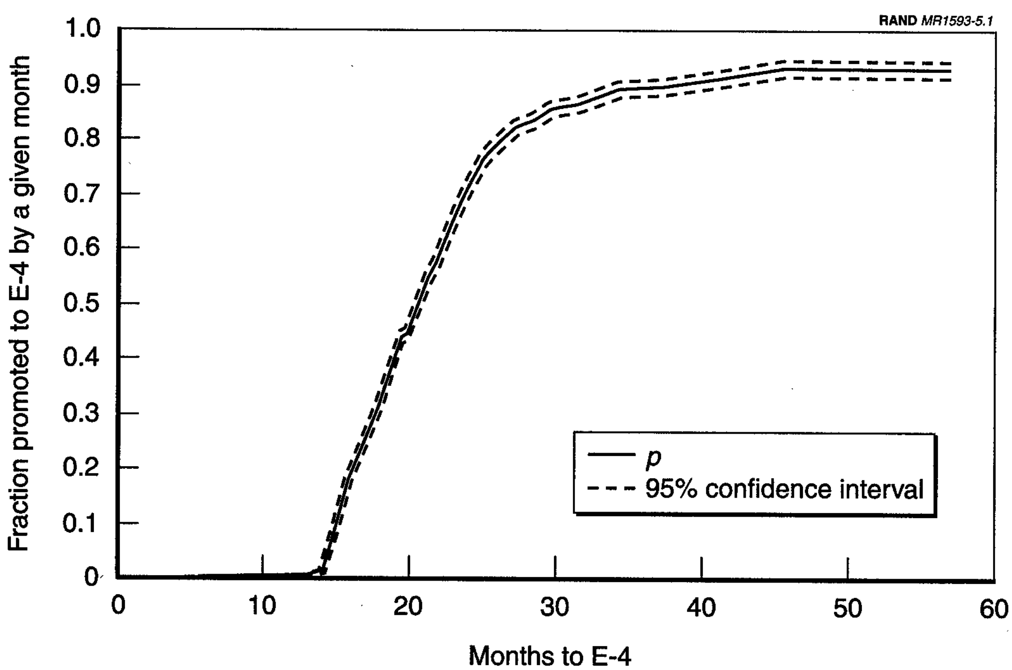

Figure 5.1—Kaplan-Meier Survival Curve for Promotion to E-4, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

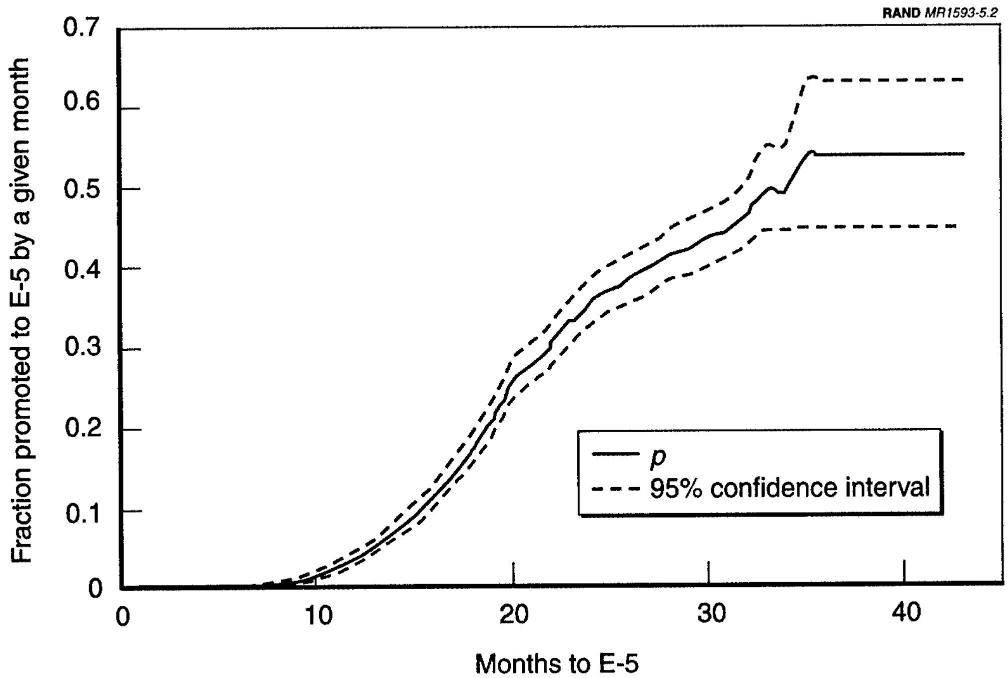

Figure 5.2—Kaplan-Meier Survival Curve for Promotion to E-5, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

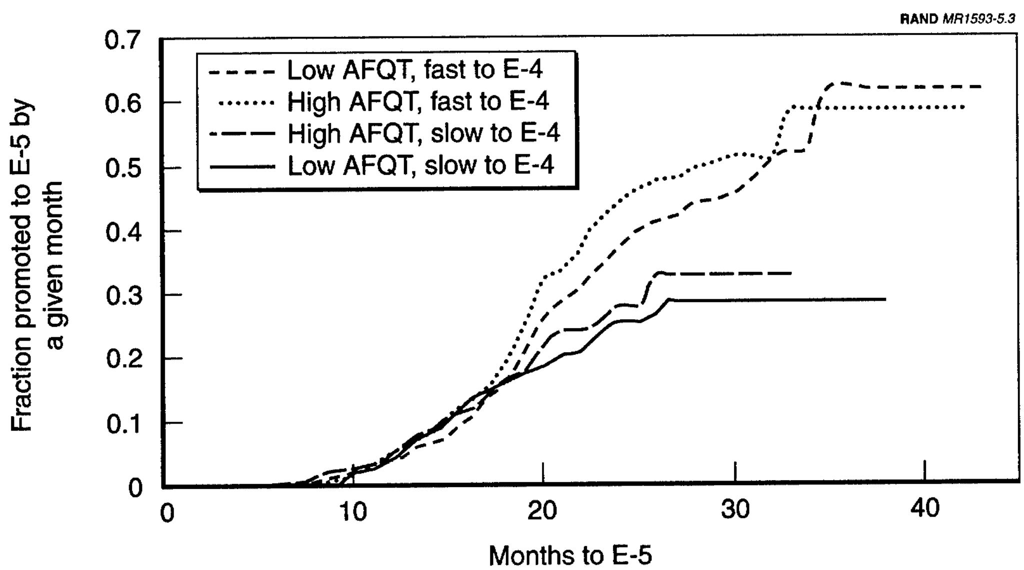

Figure 5.3—Faster-Than-Average Promotion Speed to E-4 Has Greater Effect on Speed to E-5 Than AFQT, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

Table 5.1

Parameter Estimates
Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

Parameter	Estimate	Standard Error
β_{AFQT}	0.0069611	0.0019687
γ_4	0.5553433	0.0793117
α_4	0.1360369	0.0077761
μ_4	15.30323	0.3136982
σ_4	0.9812642	0.1563201
γ_5	0.8419524	0.2282601
α_5	0.0263987	0.002572
μ_5	13.22493	0.8621972
σ_5	2.084913	0.2109257

Figure 5.4 shows the baseline hazard of promotion to E-4 implied by the estimates for α_4, μ_4, and σ_4, along with the hazards of promotion for individuals at one standard deviation of quality higher or lower than average. Figure 5.5 shows the corresponding survival curves, along with the Kaplan-Meier estimate (which does not take into account heterogeneity in quality) for comparison. Figures 5.6 and 5.7 similarly illustrate the estimates for the E-5 hazard and survival curves implied by α_5, μ_5, and σ_5. The magnitude of the quality effect can be readily seen in Figures 5.4–5.7; the E-4 hazard is nearly doubled and the E-5 hazard is more than doubled by a one-unit increase in quality.

Figures 5.8 and 5.9 illustrate how the quality index is updated over time to take into account the information revealed by promotion. Both figures are based on the parameter estimates reported in Table 5.1 and show how people with the illustrated

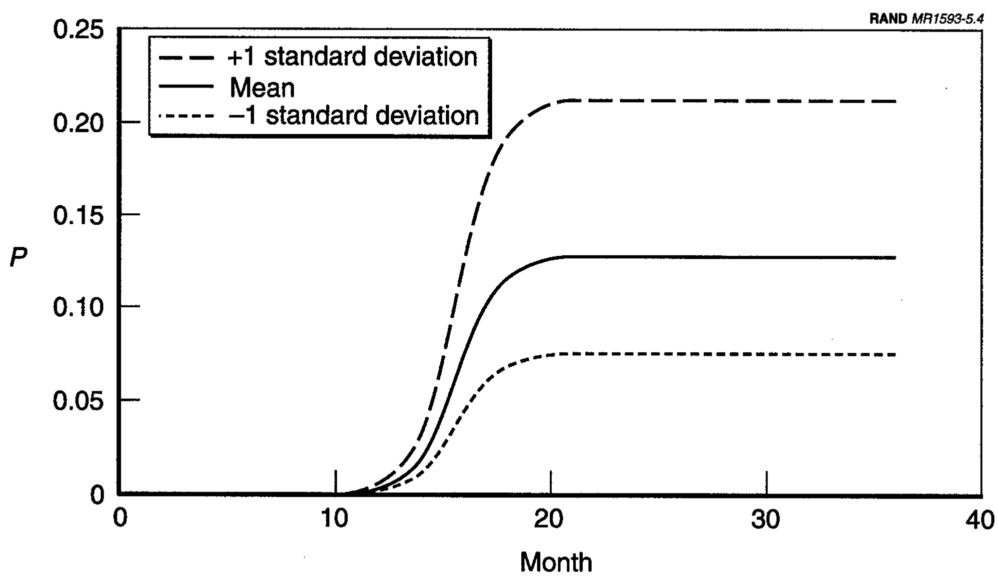

Figure 5.4—E-4 Estimated Individual Hazard, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

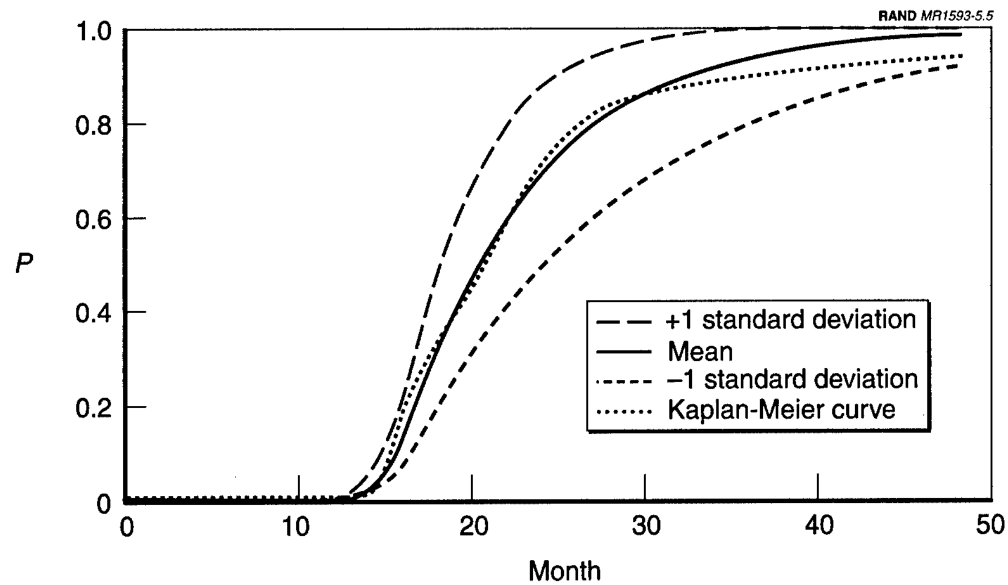

Figure 5.5—Estimated Survival Curve for Promotion to E-4, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

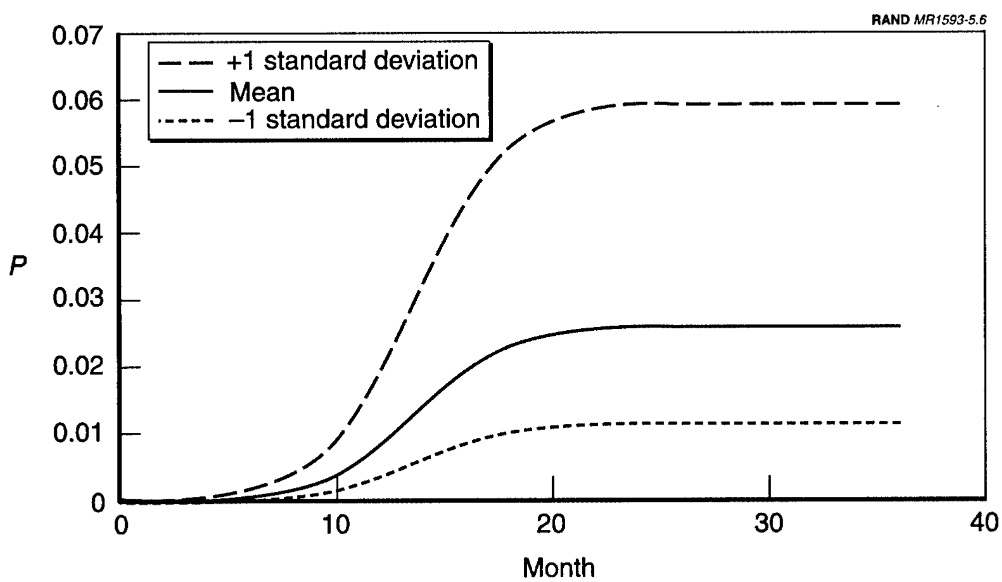

Figure 5.6—E-5 Estimated Individual Hazard, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

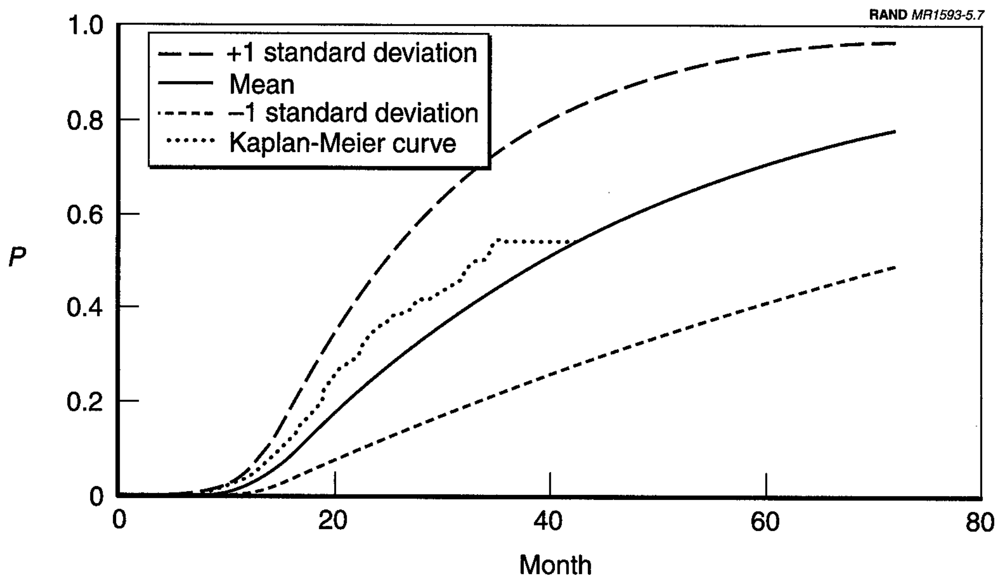

Figure 5.7 –Estimated Survival Curve for Promotion to E-5, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

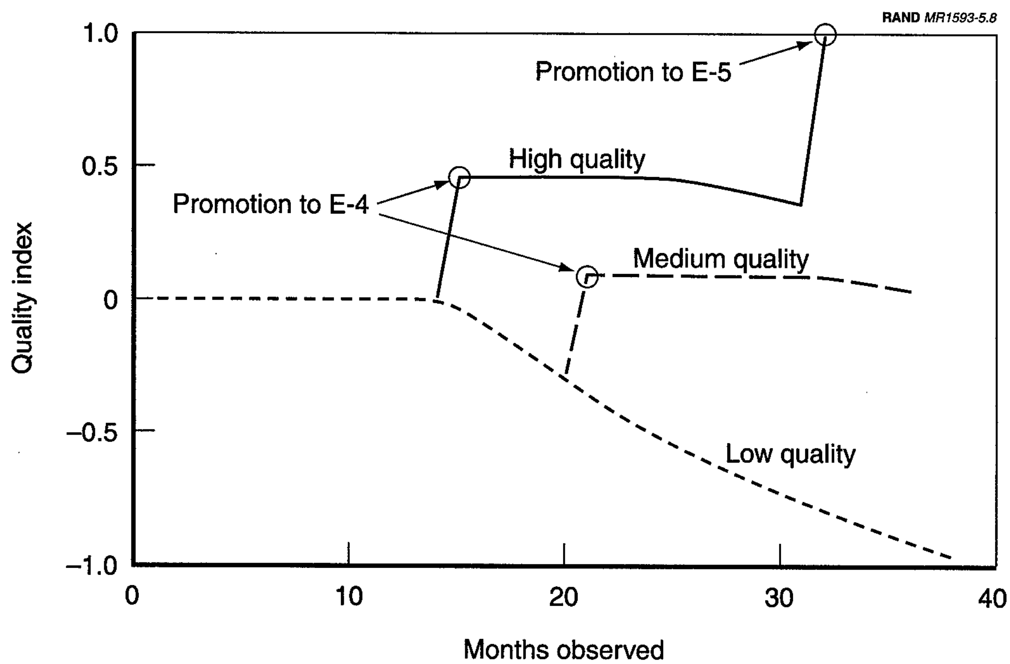

Figure 5.8—Quality Index Is Updated As New Information Is Revealed Over Time

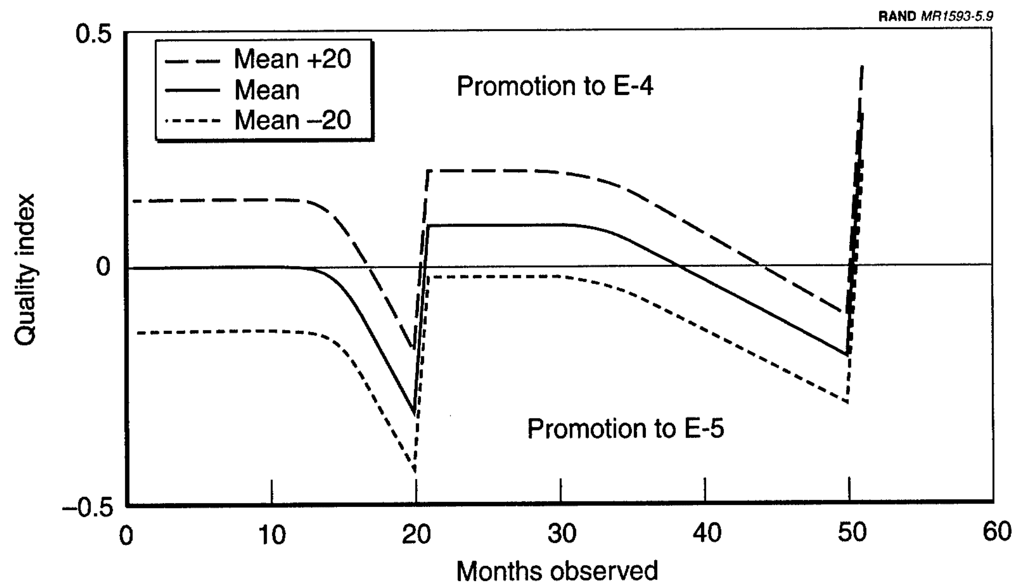

Figure 5.9—Relative Contribution of Entry Characteristics to Quality Index Diminishes Over Time

entry characteristics and promotion history are indexed over time. Figure 5.8 portrays three individuals with identical entry characteristics but different promotion histories. Judging by entry characteristics only, these three individuals would be judged to be of equal quality, but over time differences are revealed by the promotion system. Over the first year or so the index remains flat. Since almost no one is promoted to E-4 in the first year, very little information is revealed by the lack of promotion during this time. After the first year, though, people are rapidly promoted to E-4, so lack of promotion after the first year does reveal information about a person's quality. If promotion to E-4 occurs, the estimate of the quality index jumps, but it begins a gentle downward slide as peers are promoted to E-5. Finally, if promotion to E-5 occurs, the estimate of the quality index jumps again, and no more information is revealed.

In contrast to Figure 5.8, Figure 5.9 shows three individuals with differing entry characteristics and identical promotion histories. One individual has an AFQT score 20 points below the group mean, one has an AFQT score at the group mean, and one has a score 20 points above the group mean. A key point is the diminishing importance of entry characteristics over time as additional information about quality is revealed through promotion history. The difference in the quality index between the individual 20 points below the group mean and the individual 20 points above the group mean is 0.28 units at the first month, whereas by the last month it is 0.16 unit. Even though entry characteristics enter the quality index with a constant weight, computation of the expected value of the quality factor is a function of both the entry characteristics and the promotion history. The computation uses the entry characteristics to "handicap" individuals: Other things being equal, members with higher entry characteristics should be promoted sooner than are members with

lower entry characteristics. If they are not promoted sooner, the expected value of the quality factor is revised downward to take this into account. Similarly, if members are promoted sooner than expected given their observed attributes (here, AFQT), the expected value of the quality factor is revised upward—hence, the diminishing importance of entry characteristics over time.

In this service, occupation, and cohort, entry characteristics are a small component of overall quality. The coefficient on the AFQT component of the quality index, β_{AFQT}, is very small—a ten-point change in AFQT[1] would have the same impact on the hazard of promotion as a change of 0.0696 in the quality factor. Since the quality factor has a standard deviation of 1, the effect of AFQT is tiny.[2] The effect of overall quality on promotion, though, is quite large; the estimate for γ_4 implies, at the margin, a 56 percent change in the hazard of promotion for a unit change in quality. Similarly, the estimate for γ_5 implies, at the margin, an 84 percent change in the hazard of promotion for every unit change in quality.

As one might guess from the small coefficient on AFQT, the percentage of variation of the quality index accounted for by AFQT is also quite small, only 8 percent. Thus, 92 percent of the variance in the quality index is accounted for by the quality factor. This result lends plausibility to the hypothesis that entry characteristics, while significant, are a small component of overall quality as revealed through promotion.

A perennial question motivating our interest in a new measure of personnel quality is whether the armed forces have succeeded in retaining higher-quality personnel and separating lower-quality personnel. AFQT is a commonly used measure, and this sample is true to form in that the members who are retained have average scores three points lower than those who are separated—a statistically significant difference. This fact adds credence to the commonly held view that the armed forces have problems retaining high-quality people. However, if one uses the quality index, the story is reversed: The members retained are of higher quality than those separated—by 0.29 unit of the quality index. Going by the coefficient on β_{AFQT}, this is equivalent to a difference of over 40 points on the AFQT! Although this result probably overstates the case, the fact remains that the difference in quality as revealed through promotion is quite large and is in the Army's favor.

Another way of looking at this difference is by examining the effect of the quality index on a soldier's decision to stay or leave at the end of the first term. As might be expected from the above analysis, the relationship between quality and retention is positive (Table 5.2). This makes good economic sense because individuals with a higher quality index have been promoted faster (entry characteristics held constant) and can expect to have a higher earnings stream in their military career, thus making

[1]A ten-point change in AFQT is approximately one-half the standard deviation.

[2]Alternatively, this comparison can be stated in terms of the standard deviation of the expected quality factor across the members in a service-occupation-cohort combination. The empirical estimate of the expected value of the quality factor has a standard deviation of 0.477, on average, across services, occupations, and cohorts. In the case of Artillery and Gunnery (041), the standard deviation is 0.454. Thus, a ten-point change translates into a change of about one-seventh (i.e., 0.0696/0.454) of the empirical standard deviation of the quality factor, which is still fairly small.

Table 5.2

Logit Regression of Indicator Variable for Retention on Quality Index, Army Occupation 041 (Artillery and Gunnery), 1978 Cohort

Parameter	Specification 1	Specification 2
Constant	–0.382	–0.396
	(0.0428)	(0.0437)
q	1.46	1.77
	(0.100)	(0.111)
AFQT		–0.0214
		(0.00242)

NOTE: Standard errors in parentheses.

the military more appealing than a civilian career. Adding AFQT to the specification does not change the significance of the coefficient on quality, but it does show that AFQT has the expected effect on retention: If quality is held constant, soldiers with higher AFQT have a higher propensity to separate. The negative sign on AFQT has a natural economic interpretation: Soldiers with better outside opportunities (AFQT being a measure of general ability that is not specific to the military) will tend to separate, overall quality held constant. Similarly, higher-quality soldiers will tend to stay in the military, outside opportunities held constant. Thus, we see a sorting process going on, as the soldiers with a comparative advantage in the military tend to stay in the military while those with a comparative advantage in the civilian world tend to leave.

Tying these results back to the theoretical insights in Gibbons and Waldman (1999), we find support for the hypotheses that large organizations learn about the ability of their workers over time and that differences in promotion rate observed among workers are not due solely to differences in entry characteristics or human capital accumulation rates that are a function of entry characteristics. We find that in the military, as in civilian organizations, a large fraction of the variance in promotion rate is accounted for by characteristics that are only revealed by the performance of the worker on the job.

Results Across Services, Cohorts, and Occupations

The results across services, cohorts, and occupations confirm in general the results we saw above in particular. Below, we examine the size of the contribution of AFQT to the overall quality index, the percentage of the variance of the quality index explained by the quality factor, differences in AFQT and the quality index between those who stay in the military and those who leave, and the sorting behavior of individuals when they decide to stay or leave the military. Detailed tables supporting the analysis are given in Appendix B.

The analysis was done at the three-digit DoD occupational code level. For quick reference, Table 5.3 gives the one-digit occupational code definitions and cites where the interested reader can find the definitions for the three-digit codes.

Table 5.3

One-Digit DoD Occupational Code Definitions

Code	Occupation
0	Infantry, gun crews, and seamanship
1	Electronic equipment repairers
2	Communications and Intelligence
3	Medical and Dental Specialists
4	Other Technical and Allied specialists
5	Functional Support and Administration
6	Electrical/Mechanical equipment repairers
7	Craftsmen
8	Service and Supply Handlers

SOURCE: *Occupational Conversion Manual, Enlisted/Officer/Civilian,* Department of Defense, Office of the Assistant Secretary of Defense, Force Management and Personnel, DoD 1312.1-M, 1997.

Across services, occupations, and cohorts, the coefficient on the AFQT component of the quality index is generally quite small. (See Appendix B, Tables B.1 through B.4.) The median value of β_{AFQT} across occupations and cohorts is 0.009 for the Army, 0.018 for the Air Force, and 0.012 for the Marines (see Figure 5.10). Since the quality factor has a standard deviation of 1, this means the effect of AFQT is tiny: Even for the Air Force, a ten-point difference in AFQT translates into only about one-fifth of a standard deviation of the quality factor.[3] However, it is interesting to note the difference between the Air Force and the other services—the Air Force's median coefficient is twice that of the Army's, and one-and-one-half times that of the Marine Corps'. The greater role of AFQT in the Air Force quality indexes may arise from the Air Force's greater reliance on written examination to measure the skills and knowledge required for promotion.

Across services, occupations, and cohorts, the percentage of variance in the quality index accounted for by the member-specific component of quality tends to be very large. As shown in Figure 5.11, the median percentage accounted for by this factor across occupations and cohorts is 92 percent for the Army, 54 percent for the Air Force, and 87 percent for the Marine Corps. The lower percentage for the Air Force makes sense given the higher coefficient on AFQT observed above. However, even for the Air Force over half of the variance in the quality index is accounted for by the unobserved component of quality that is revealed by promotion. (Statistics by service, cohort, and occupation are presented in Appendix B in Tables B.5 through B.7.)

In some cases, the variance attributable to the unobserved quality factor is close to 0. These cases are generally where either γ_4 or γ_5 are close to 0. If one of these coefficients is close to 0, then quality does not appreciably shift one of the hazards, and the quality factor cannot be identified. Thus all the weight of the quality index goes to AFQT.

[3]Ten points is approximately one-half a standard deviation on the AFQT scale.

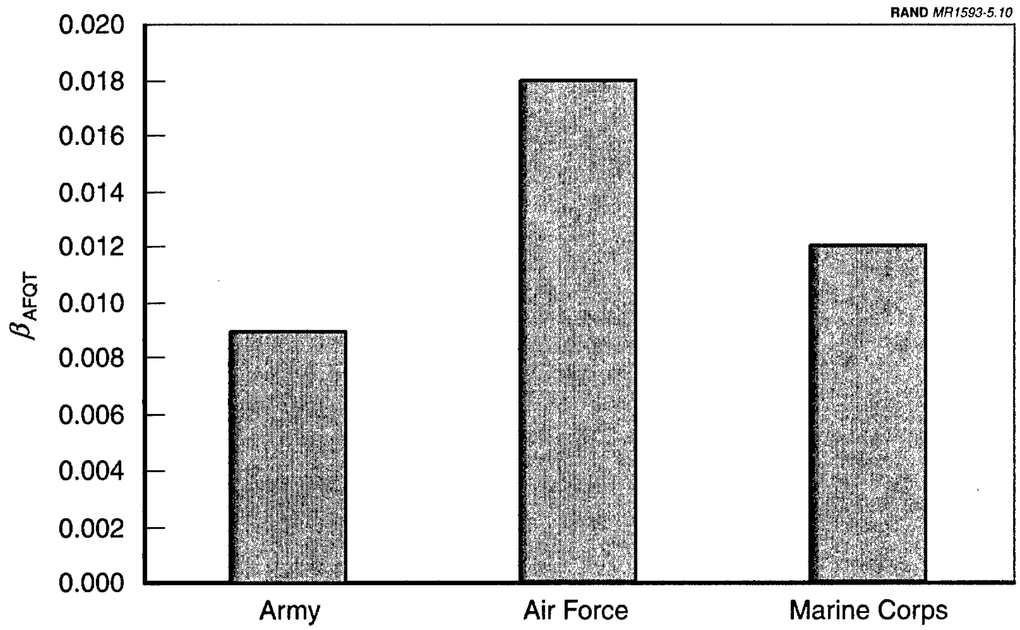

Figure 5.10—The Contribution of AFQT to Overall Quality Is Generally Quite Small

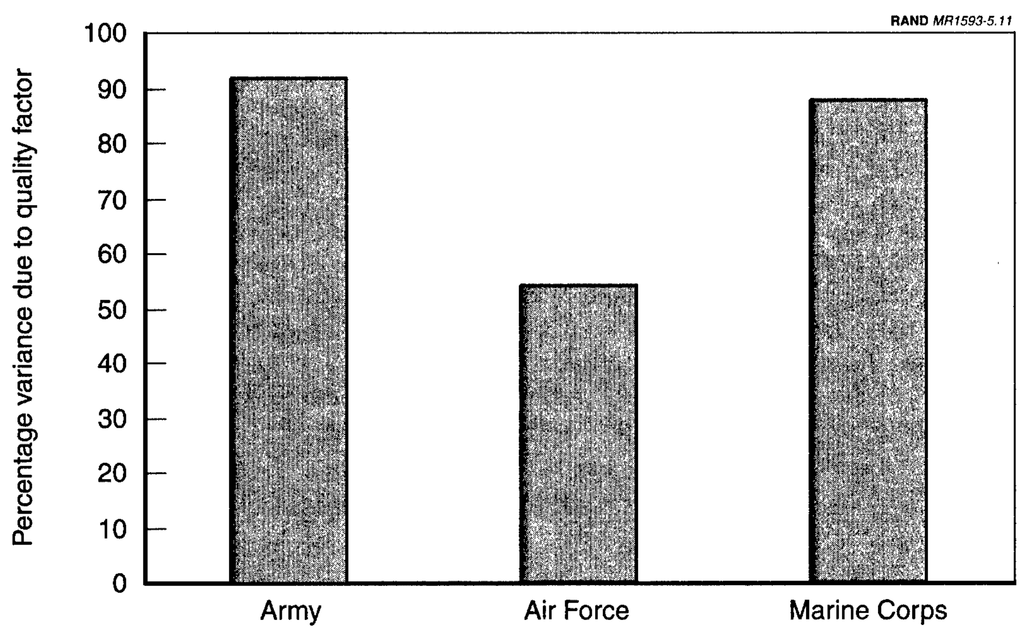

Figure 5.11—The Quality Factor Accounts for a Large Percentage of Overall Variance in Quality

Across services, occupations, and cohorts, the AFQT scores of people who decide to stay in the military tend to be lower than the scores of those who leave. The median difference in mean AFQT across occupations and cohorts is –3.0 for the Army, –0.7 for the

Air Force, and –2.3 for the Marine Corps (Figure 5.12). However, just as in the exemplar case we looked at above, the overall quality index of those who stay tends to be higher than the overall quality of those who leave. The median difference in mean quality across occupations and cohorts is 0.21 for the Army, 0.11 for the Air Force, and 0.32 for the Marines (Figure 5.13). If we use the median values for β_{AFQT} as a gauge, this quality difference is approximately equivalent to an AFQT difference of 23 points for the Army, 6 points for the Air Force, and 27 points for the Marines (Figure 5.13). So the overall measure of quality that incorporates the information revealed through promotion timing tells quite a different story from a measure that relies solely on entry characteristics. (AFQT and quality statistics by service, cohort, and occupation are presented in Appendix B, Tables B.8 through B.13.)

We observe the same sorting behavior across services, occupations, and cohorts that we noted above in our exemplar case. That is, people with a comparative advantage in the military tend to stay, and people with a comparative advantage in the civilian world tend to separate. This is reflected by Tables B.14 through B.19 in Appendix B, which summarize the results of a logit regression of an indicator variable for reenlistment on the quality index and on AFQT. The first of each pair of tables shows the coefficient on the quality index, and the second shows the coefficient on AFQT. With only a few exceptions, the coefficient on the quality index is positive and significant at the 1-percent level, and the coefficient on AFQT is negative and significant at the 1-percent level. This echoes the results we saw above for a single service, occupation, and cohort: Higher-quality people, AFQT held constant, will tend to reenlist; people with higher AFQT scores, overall quality held constant, will tend to separate.

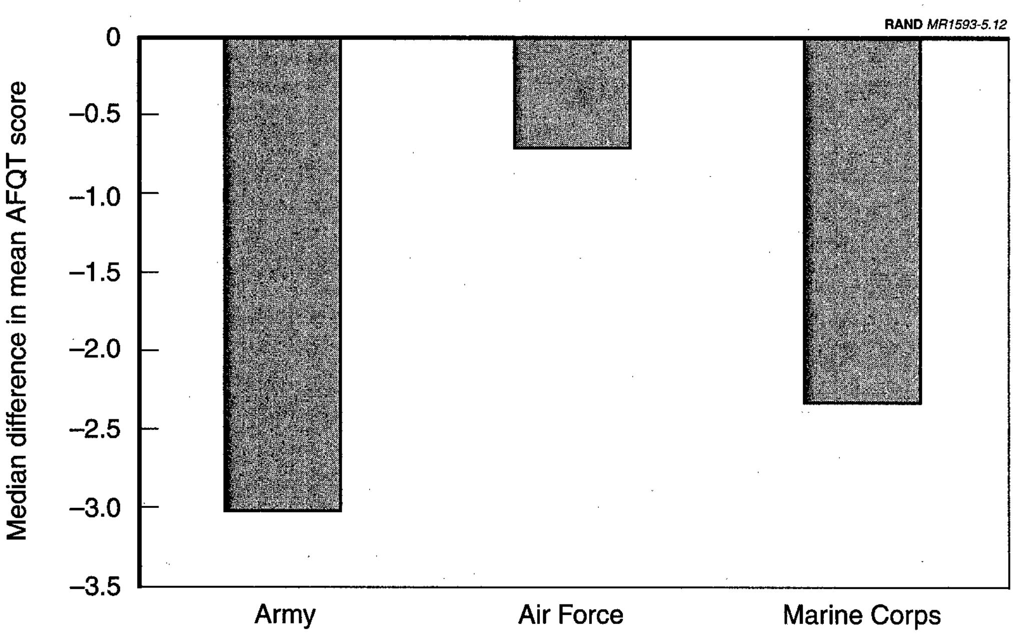

Figure 5.12—People Who Stay Have Lower AFQT Scores on Average

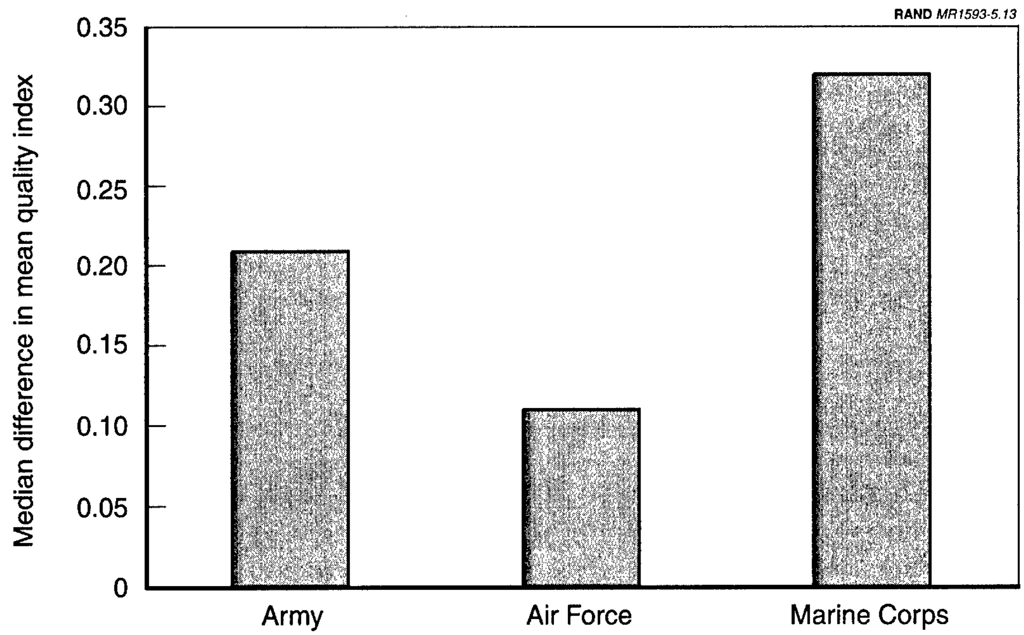

Figure 5.13—People Who Stay Are Higher Quality on Average

The Case of the Navy

Above we presented results for all services except the Navy. This is for good reason: It proved in many cases impossible to get reliable estimates of the quality index for the Navy. The reasons are interesting and may have an implication for Navy promotion policy.

We can gain some intuition by examining Figure 5.14. It shows the cumulative percentage promoted to E-5 by months spent in E-4. The Navy chart looks different from those of the other services. Whereas the curve showing the cumulative percentage promoted to E-5 is relatively smooth for the Army, Air Force, and Marines, the curve for the Navy looks like a staircase. This is because the vast majority of promotions in the Navy are lumped together in six-month increments. This lumping means that the Navy does not make fine distinctions in performance when making promotion timing decisions. People of different quality are lumped together. Unfortunately, since our model uses correlations in promotion timing across E-4 and E-5 to identify unobserved quality, the lumping weakens the correlation and makes this identification difficult or impossible.

The policy implication is this: The Navy is apparently not taking full advantage of the flexibility it has in promotion timing. By making finer distinctions in performance and timing promotions appropriately, the Navy may be able to do a better job of encouraging higher-quality sailors to reenlist and lower-quality sailors to separate. If the Navy perceives sorting out the good from the bad to be a problem, it may want to explore alternatives to its present policy of lumping promotions together in six-month intervals.

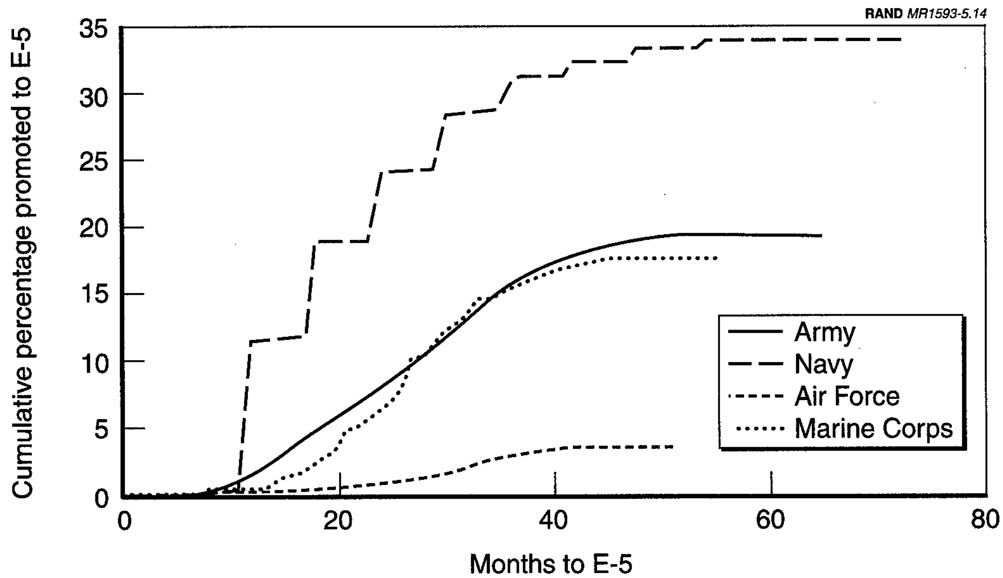

Figure 5.14—Navy Promotion Timing Does Not Distinguish Among Small Differences in Performance

PROBLEMS IN ESTIMATING THE MODEL

For about 10 percent of the samples we took, we were not able to estimate the model. This was in large part due to the low fraction of individuals promoted to E-5 in many of these samples during the first term. In a logit regression of an indicator variable for unsuccessful estimation on the percentage promoted to E-5, the coefficient on percentage promoted is large, negative, and significant. Tables B.20–B.22 in Appendix B show the fraction promoted to E-5 in the first term by year and occupation. Those samples with fewer than 1,000 observations are in the light gray cells; of the remaining cells, those that are darker gray represent where we were unable to estimate the quality model because the model did not converge.

This is an increasing problem over time, because the fraction promoted to E-5 in the first term has largely been declining. Figure 5.15 shows the median fraction promoted to E-5 for those occupations with more than 1,000 individuals. In future work, it would be desirable to incorporate the reenlistment decision into the model, so that we could use the promotion histories of those who reenlist to supplement the quality information revealed during members' first term.

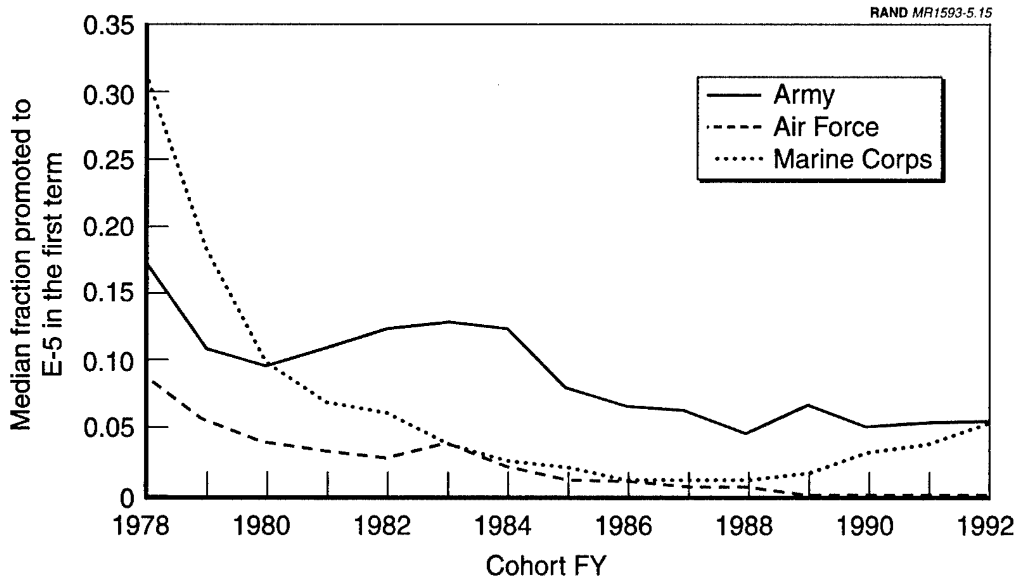

Figure 5.15—Fraction Promoted to E-5 in the First Term Has Declined

Chapter Six

CONCLUSIONS

VALUE OF A NEW MEASURE OF QUALITY

Our objective in this research was to expand the definition of enlisted personnel quality in a way that includes information revealed through actual performance during the first term. As mentioned earlier, the customary measures of quality, namely, AFQT score and HSDG status, are excellent point-of-entry measures but provide only limited information about how well a member will perform during the first term. Moreover, because the military cares about who stays and who goes, it is important not to ignore information revealed "on the job." Thus, this important question motivated our work: Is the military keeping the members with the best performance and the best potential? The methodology we used provides one approach to answering that question. Our approach has the advantage of using much of the available data on members' performance during the first term. The approach capitalizes on the services' specific, well-understood promotion systems and the fact that the time of promotion reflects the member's performance with respect to the promotion criteria. That is, high performers are promoted sooner.

IDENTIFYING AND RETAINING HIGH-QUALITY MEMBERS

Studies of the relationship between reenlistment and AFQT generally find that AFQT is negatively related to reenlistment. Higher-AFQT members are somewhat more likely to leave the military than are lower-AFQT members. We found that AFQT has a positive effect on the estimate of quality that we compute. This positive effect has its roots in the shorter promotion times of higher-AFQT members. But AFQT is only one piece of estimated quality; the other piece is the member's own component of quality, or the quality factor.

We think the quality factor reflects the interaction of taste for the military, effort, and ability. A high-taste member presumably has a stronger incentive to exert effort for career advancement. This member wants to make a good career in the military and recognizes that future opportunities depend on demonstrated performance. High ability enables the member to accomplish tasks faster and do a wider variety of tasks for a given amount of effort. That is, ability can boost a high-taste, high-effort member's progress toward promotion. We have described quality not as "ability" or "aptitude" but as the quality of job match between the member and the military. A

good match indicates that the member, given taste and ability, has made the effort to perform *persistently* well and that the service, having viewed the member in comparison with other members being judged by the same criteria, recognizes the superior performance.

We found that AFQT has a negative effect on reenlistment and that the quality factor has a positive effect. But we have just argued that the quality factor is a combination of taste, ability, and effort, thus raising the concern that the high-quality members who stay might have high taste and high effort but not high ability. We think this is unlikely. It seems reasonable to assume that AFQT score, which reflects cognitive ability and achievement, is positively correlated with other dimensions of ability. It also seems reasonable that ability is not correlated with taste for the military. Under these assumptions, and remembering that the relationship between AFQT and reenlistment is slight though negative, it is improbable that members who leave will be disproportionately high-ability, holding AFQT constant. By the same token, members who stay in the military are likely to have high taste, high effort, and at least reasonably high ability.

We also found that the quality factor accounts for a large fraction of the variance of quality among members at the end of the first term. A thumbnail summary is that the quality factor accounts for 92, 54, and 87 percent of the variance for the Army, Air Force, and Marine Corps, respectively, with AFQT accounting for the remainder. This finding gives strong empirical support to theoretical literature that stresses the role of firms' learning about the quality of workers through their performance on the job (e.g., Gibbons and Waldman, 1999).

Our approach may seem overly complicated. If information about a member's quality is contained in promotion times, it would seem more direct simply to use the time to E-4 and the time to E-5 to build a first-term quality measure. But most promotions to E-5 do *not* occur in the first term, so time to E-5 is often impossible to observe. Allowing for censored observations, one could estimate an E-5 promotion-hazard function and predict a member's expected time to E-5. But the expected time to E-5 is not good enough because it assumes, in effect, that the member is on a par with his or her peers. We instead want to know whether the member is faster or slower to E-5 *than expected* given the member's observed characteristics (AFQT). The same point applies to E-4. We therefore implemented a two-stage procedure: Estimate the E-4 and E-5 promotion-hazard functions, then use Bayesian updating to infer the expected value of a member's quality factor.

It may also seem that the positive relationship we find between quality and reenlistment is circular, but it is not. All the information that goes into the estimate of quality comes *before* the reenlistment decision, and the reenlistment decision itself is not factored into the quality estimate. That is, in a formal sense, the estimate of quality does not depend on the reenlistment decision. Furthermore, we think two forces drive the relationship between quality and reenlistment. The first is the member's taste for the military; the second is the effect of current high performance on

future opportunities. We expect the interaction of taste, effort, and ability to affect performance—and hence estimated quality. We also expect taste to affect retention. Members with high taste are of course more likely to reenlist, and high-quality members are more likely to reenlist because they can expect a military career of better, more challenging assignments and higher pay if they keep up their performance.

It is not a foregone conclusion that high-quality members are more likely to stay in the military. Taste for the military will tend to keep them in the military, but military training and experience often translate into private-sector job opportunities. Consider a member who trains in a high-tech skill that is highly transferable to civilian employers. The member has strong self-interest to complete training, do well on the job, and generally demonstrate competence. Moreover, since training is ample and free, there is all the more reason to learn as much as possible while in the military. The member can leave with a good record and a good set of skills. The Air Force is fairly explicit about this: It denotes skill level by the terms "apprentice," "journeyman," "craftsman," and "master craftsman" and these descriptors are easily communicated to potential private-sector employers. Thus, since high-quality members could easily leave the military, it is reassuring that they tend to stay—and it is reassuring to know that stayers have had above-average quality (holding AFQT constant).

USES OF THE NEW MEASURE OF QUALITY

We have used the new measure to show that at the end of the first term, the military tends to keep higher-quality members even though it loses, to a slight degree, higher-AFQT members. These findings confirm the findings of Ward and Tan (1985), who examined eight specialties in the early years of the All-Volunteer Force—two specialties in each service for members who entered service in 1974. Our 334 combinations of service, occupation, and cohort for 14 cohorts, 1979 to 1992, provide massive confirmation of the importance of AFQT in quality, the greater importance of the member's quality factor, and the retention of higher-quality members at the end of the first term.

In future work, we and our colleagues plan to use our quality estimates to learn whether high-quality members have higher retention throughout their career and rise to higher ranks more rapidly. If this is the case, the results will indicate that the military personnel management and compensation systems are generally working well. It is not a foregone conclusion that the military will disproportionately keep members with a higher-quality of job match, and it would be a matter of concern if they did not.

Furthermore, our research provides a replicable method to determine how policy changes affect the retention of high-quality members. For the same reason that one is interested in whether pay, promotion, training, or career advancement opportunities are attractive enough to hold onto high-AFQT members, one is interested in whether high-quality members stay.

LIMITATIONS OF THE MODEL

Although this modeling exercise has been largely successful, we have found the model to have an Achilles' heel. The model can only be estimated if a sufficiently large fraction of first-term enlistees are promoted to E-5. This is cause for concern because the fraction promoted to E-5 by the end of the first term is declining. Thus, it would be desirable to extend the model to include the reenlistment decision, so that we could use the promotion histories of those who reenlist to supplement the quality information revealed during members' first term.

Several other limitations could be addressed in further work. We relied on the speed of promotion to indicate the quality of the job match between the member and the military. But we did not validate whether promotion speed reflected "job performance." As we stated, our findings are conditional on the assumption that promotion speed reflects the quality of the job match. It may be worthwhile to consider studies that validate the relationship between promotion speed and objective measures of job performance. In the military, job performance has many aspects; the member is responsible not only for doing certain tasks that present themselves but also for being *ready* to do a full range of mission-essential tasks. Therefore, validation studies cannot simply look at a service member as though he or she were a worker doing a single assigned task.

Further, although we have estimated models for different cohorts, it is difficult to compare across cohorts. Such comparisons would help determine whether or not the services have been increasingly successful in keeping high-quality members. The concern is that the quality factor is measured on a relative basis; it depends on a member's promotion speed relative to that of peers. The services do not necessarily slow down the promotion tempo for cohorts of lower absolute quality or speed it up for cohorts of higher absolute quality. Consider a member with high absolute quality. The member would be promoted quickly if his or her peers were of low absolute quality but more slowly if the peers were of high absolute quality. The best available metric of absolute quality is AFQT score, and it enters into the determination of the member's expected quality factor. AFQT can be used as an absolute quality measure to facilitate cross-cohort comparisons in terms of our broader measure of quality. We have described an approach for making cross-cohort comparisons in Appendix A, but we recognize that future work is required to refine and implement the approach.

Second, the length of time spent in the first term is treated as exogenous to the promotion process and to the determination of quality. That is, both attrition/completion and choice of first-term length are taken as given. But they might contain information about a person's quality. The model might be extended to include equations for attrition and term-length choice. But implementing this approach requires data that are not readily available. The choice of term length depends on the choice set offered to the member at the time of enlistment, i.e., whether two- and six-year terms are offered, or only three- and four-year terms, or even only four-year terms. It also depends on the enlistment incentives available, e.g., a larger enlistment bonus or educational benefit for a four-year term than for a three-year term. Perhaps the term-length choice set could be approximated by observing the actual range of

choices made by all members of a cohort entering service in a given six- or twelve-month window. But data on enlistment incentives would still be needed.

The model could be extended to E-6 and E-7. This would make it possible to test whether the structure of quality (the effect of AFQT on quality and the value of the member's quality factor) is the same as it is at E-4 and E-5. In the higher ranks, more of a premium is placed on leadership, supervisory, and managerial skills as opposed to knowledge and proficiency in specific occupational tasks. Extending the model to higher ranks involves combining retention behavior as well. This is necessary because the retention process is expected to be selective with respect to quality. Quality could change if the member's level of effort changes and the change persists. If the perceived time to E-6 or E-7 is long, or if promotion itself is improbable before reaching an up-or-out constraint, a member may exert less effort than previously. A change in effort or a change in the factors required for promotion, e.g., the ability to lead, the ability to communicate clearly, or the ability to work in teams, could lead to a change in the estimate of unobserved quality.

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STANDARDIZATION AND COMPARISON BETWEEN GROUPS

This appendix outlines an approach to two topics relevant to possible future applications involving estimates of the quality model. These are (1) the standardization of expected quality and (2) the comparison of quality across groups.

STANDARDIZATION

The quality model can be used to compare expected quality across groups (cohorts, occupations, and services). However, standardization is required to make these comparisons meaningful. This is because, for reasons unrelated to quality, groups can differ in the percentage promoted to E-5 within the first term and in the influence of quality on promotion speed. We therefore want to adjust for these differences and focus on quality as defined by $q_i = \beta x_i + \varepsilon_i$.

An example provides the rationale for standardizing. In the late 1970s and early 1980s, many signs indicated poor personnel outcomes: Recruits had low AFQT scores and education, attrition was high, and reenlistment rates were low. High attrition rates and low reenlistment rates, coupled with a fairly constant overall force size and rigid manning requirements for personnel by rank, led to more-rapid promotions. At that time, in other words, the military personnel system advanced low-quality cohorts more rapidly through the ranks. This produced a lower mean time to promotion and possibly a smaller variance in time to promotion. Further, because of the faster promotion rates, a higher percentage of personnel were promoted to E-5 in the first term. Consequently, if simply judged by promotion speed, these low-quality cohorts might be mistaken for high-quality cohorts compared with later cohorts that faced slower promotion speed.

Standardizing the Unobserved Component of Quality

The parameters of the baseline hazard function control for the median time to promotion, dispersion of time to promotion, and asymptotic level of the hazard rate. Therefore, when the model is estimated for different groups, the baseline hazard controls for groups' differences in median time, dispersion, and asymptotic hazard. With these differences controlled, we can isolate the effect of quality on shifting the baseline hazard function. Further, the quality shift effect is comparable across groups because quality is always measured in units of standard deviation. In particular,

when we handicap and control for the service member's entry characteristics, any remaining shifts come from draws of unobserved quality, which has a standard normal density.

Still, it is worth adding a word of caution: The statistical standardization of expected quality must be distinguished from the meaningful revelation of quality. More bluntly, if quality does not make a difference in determining promotion speed, we cannot learn about quality from promotion speed. If the promotion process in one group is insensitive to quality, then even though that group might contain equally many high-quality personnel, their quality cannot be as well detected through this method, which relies on promotion speed to indicate quality.

Thus, our confidence in the use of promotion speed to detect quality depends on the nature of the promotion system and its comparability across groups (e.g., occupations, services) and over time. Fortunately, the military promotion system is not a rubber stamp process but involves explicit criteria related to knowledge, skills, performance, attitude, and potential (Williamson, 1999). Still, because skills, knowledge, and activities differ across occupations and services, the relationship between quality and promotion may differ. And because equipment and doctrine change over time, even comparisons within an occupation in a service may contain elements of noncomparability over a long enough time. As a working assumption, though, we place greatest confidence in comparisons of expected quality at the level of occupation within a service, or grouping of similar occupations within a service.

Standardizing for Percentage Promoted to E-5

Two groups could have the same intrinsic quality (i.e., the same β in $q_i = \beta x_i + \varepsilon_i$), but one group could have a higher percentage promoted to E-5 within the first term. This is an important difference because time to E-5 is a key contributor to the estimate of expected quality. Suppose that only 10 percent of personnel reached E-5 in the first term. Then for 90 percent there would be uncertainty over whether E-5 would be reached rapidly or slowly relative to the group average. This uncertainty would be handled probabilistically by the expected value computation, with a low chance of a very early promotion (given that one did not occur in the first term), higher chances of promotion near the mean time, and a low chance of a very late promotion. As a result, the expected value of a member's quality factor would largely look like that of the a priori average person (for whom time to promotion had not yet been observed). Since the model norms expected quality to 0, expected value of this member's quality factor would therefore be approximately 0.

The situation improves as the percentage promoted to E-5 increases, as can be seen by going to the other extreme of supposing 90 percent of personnel reached E-5 in the first term. Then we would know their exact residual in the time-to-promotion equation and could tell whether they were fast or slow, information that the model would use to provide a more precise reading of the member's quality. Moreover, even for the 10 percent who were not promoted and therefore do not have a known date of promotion, we do know their promotion must occur in the slowest decile.

The model will essentially use the *expected value* of the quality factor of the *slowest decile* and so assign a low value to the member.

By implication, one group could appear to be higher-quality than another group because the first group had, say, 40 percent promoted to E-5 in the first term versus the second group's 10 percent. The appearance of higher quality would simply be the result of *greater revelation* of quality during the first term, not higher quality. To control for this apparent difference when comparing two groups, expected quality can be computed under the constraint of taking only the first 10 percent promoted to E-5 from the group having 40 percent promoted. For percentiles 11–40, we would compute their expected quality as though the date of E-5 promotion were unknown. In this way, both groups have the same percentage promoted to E-5—in actuality for one group and by construction for the other.

But although we gain comparability between the groups, we suffer a significant loss of information about the revealed quality of the other 30 percent who were also promoted. There seems to be no way around this situation if we rely on time to promotion to indicate quality.

However, data on promotion points might mitigate this problem. Promotion speed depends on a member's promotion points relative to peers and on the minimum score for promotion ("cut score"). An E-4 service member gradually accumulates promotion points toward E-5. Observing these promotion points as of the end of the first term (or the date of exit from service, if earlier) provides an ongoing record of performance and merit. Service members who accumulate promotion points more rapidly will be promoted more rapidly. Thus, promotion points are a bellwether of time to promotion. Moreover, because promotion points are not censored,[1] they should provide fairly accurate information about a person's likely place in the promotion queue. It is possible to estimate the quality model by using, alternatively, eight E-5 promotion points or time to E-5. Doing so would allow comparison of (a) the correspondence between expected quality based on promotion points versus time to promotion, and (b) the gain in information about quality from promotion points versus time to promotion.

COMPARING QUALITY BETWEEN GROUPS

We are interested in how to compare expected quality between two groups—call them group 1 and group 2. As we know, expected quality for a member equals a linear sum of entry characteristic effects and the expected value of the quality factor. The entry characteristic effects are linear, but the expected quality factor depends nonlinearly on the model parameters and the entry characteristics. Moreover, the expected quality factor cannot be computed without counterfactual values of pro-

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[1]By *not censored,* we mean that promotion points are observed outright. For example, a person might have 320 promotion points as of a certain date, whereas if promotion points were censored, we might know only that the person had 200 promotion points or more. Similarly, if a person has not been promoted as of the end of the first term, say the 48th month of service, we know only that the month of promotion will be greater than 48 months.

motion outcomes, which indicate the promotion outcome that would have occurred if a member of group 1 were placed in the context of group 2.

Even though expected quality contains a nonlinear term, it is useful to begin our discussion with reference to the usual approach to group comparisons applied to linear functions. In these models, the average predicted value, say $\overline{w}$, equals the prediction at the average of the explanatory variables, say μ. The difference between groups in the predicted mean can be partitioned into a weighted sum of the difference in parameters and the difference in explanatory variable means:

$$\overline{w}_1 - \overline{w}_2 = \beta_1\mu_1 - \beta_2\mu_2 = (\beta_1 - \beta_2)\mu_1 + (\mu_1 - \mu_2)\beta_2.$$

The quality model differs from this linear-model comparison. In the quality model, the explanatory variables have been differenced from the group mean and, as mentioned, expected unobserved quality is nonlinear.

To see the effect of differencing the explanatory variables from the mean, we will consider the population of group 1 and begin by focusing on member *i* of that group. Altering the notation we have used throughout this report, let $x_i - \mu_1$ be *i*'s entry characteristics differenced from the group 1 mean and $x_i - \mu_2$ be the characteristics differenced from the group 2 mean. The a priori difference in expected quality for this person when placed in group 2 versus group 1 is

$$q_{i,1} - q_{i,2} = \beta_1(x_i - \mu_1) - \beta_2(x_i - \mu_2).$$

Because this is an a priori difference, the expected value of the quality factor is 0 and so does not appear. To form the group difference in expected quality, we average over the members of the group 1 population, finding

$$\begin{aligned}\overline{q}_1 - \overline{q}_2 &= \beta_1(\mu_1 - \mu_1) - \beta_2(\mu_1 - \mu_2)\\ &= -\beta_2(\mu_1 - \mu_2)\end{aligned}$$

since $\overline{x}_1 = 0$. This can be rewritten as

$$\overline{q}_1 - \overline{q}_2 = \beta_2(\mu_2 - \mu_1).$$

It follows that if group 2 has higher average entry characteristics than group 1 ($\mu_2 - \mu_1 > 0$) and the effect of those characteristics on quality is positive ($\beta_2 > 0$), then $\overline{q}_1 - \overline{q}_2 > 0$. That is, group 1 members will have higher average quality when judged against their own average than when judged against the higher average entry characteristics of group 2. For the low-AFQT, low-education cohorts of the late 1970s and 1980s, many personnel whose x_i was above average in their own cohorts will have below-average values of x_i when placed in the context of high-AFQT, high-education cohorts. This fact alone will contribute to their having a low expected quality relative to that of the high-quality cohorts.

The next step toward group comparisons is obtaining counterfactural values of promotion outcomes. The promotion outcome is observed only in the context of a member's own cohort and therefore must be imputed in the context of other cohorts. The reason for the imputation echoes the preceding discussion. Suppose groups 1 and 2 have *identical* means; this allows us to abstract from the kind of differences discussed in the preceding paragraph. Suppose the member's own group generally had fast promotions but the member had a slower-than-expected promotion in that context, given the member's entry characteristics. In other words, actual promotion time was slower than handicapped time, which is the time expected on the basis of entry characteristics. Next, place the member in a group that generally had slow promotions. We may now find that the member's observed promotion time is faster than average relative to the promotion speed in this group, again controlling for entry characteristics. Therefore, a member who is relatively slow in his or her own group and whose quality factor is expected to have a negative value will be relatively fast in the other group and therefore will be expected to have a positive quality factor. Notice that this does not depend at all on differences between the explanatory variable means in the groups because they are assumed to be equal. Instead, the difference depends on military personnel system factors that govern the speed of promotion for each group. Still, in the more general case, differences in means must also be taken into account.

To address the problem of imputing promotion outcomes in group 2 for a member of group 1, we propose a procedure that first asks what the promotion outcome would have been with group 2 parameters but keeping the member at group 1 means—i.e., keeping the member's entry-level quality constant—and then adjusts the promotion outcome for the difference in entry quality that arises from a comparison of the member with group 2 means instead of with group 1 means.

For the first part of the procedure, we seek a promotion outcome, denoted t_i', such that the probability of a member's being promoted by t_i' in group 2 is the same as the probability of being promoted by t_i in his own cohort, given entry characteristics differenced against group 1 means. By finding t_i', we are able to place the member in the same position on the time-to-promotion distribution for group 2 as on the group 1 distribution.

We express this as follows. Define $x_i - \mu_1$ as above. Let θ_1 and θ_2 be the parameters for group 1 and group 2, respectively. Let t_i be the actual promotion outcome and let t_i' be the promotion outcome we want to find. Finally, let $F(\ )$ be the time-to-promotion distribution. Then, t_i' is defined by the relationship

$$F(t_i' \,|\, x_i - \mu_1, \theta_2) = F(t_i \,|\, x_i - \mu_1, \theta_1).$$

It is feasible to compute t_i' with this relationship because, once the quality model has been estimated, the time-to-promotion distribution can be derived from the estimates. Furthermore, the relationship conditions t_i' on the parameters appropriate to each group. Thus, for example, if the average time to promotion is faster in group 2, that is reflected in the mean of its distribution. The result of this step is to assign a promotion outcome that places the member as far ahead or behind his handicapped

time of promotion in group 2 as he is in his own group, holding his entry characteristics constant with respect to the group 1 mean.

Given t_i', the next step is to adjust it for any difference between group 1 and group 2 mean entry characteristics. In this step, we are keeping t_i' the same and working within the structure θ_2 of group 2, whereas in the first step we shifted from the structure of group 1 to that of group 2. We ask, What is the probability of promotion by t_i' if the member's entry characteristics change from $x_i - \mu_1$ to $x_i - \mu_2$ in the context of group 2? This is expressed as $F(t_i' | x_i - \mu_2, \theta_2)$. For instance, if group 2 has a higher mean than group 1, then the member's entry characteristics are relatively poorer: $x_i - \mu_2 < x_i - \mu_1$. As a result, the chance of being promoted by t_i' is lower:

$$F(t_i' | x_i - \mu_2, \theta_2) < F(t_i' | x_i - \mu_1, \theta_2).$$

Once we have obtained $F(t_i' | x_i - \mu_2, \theta_2)$, we can take the first derivative to produce the probability density at t_i': $dF(t_i' | x_i - \mu_2, \theta_2) = p(t_i' | x_i - \mu_2, \theta_2)$. The probability density is used in computing the expected quality factor.

Note that we can use the above approach in different variants, depending on the comparison to be made. Specifically, we can compute a member's expected quality factor as

- ε_{i11} for group 1 parameter values and group 1 means
- ε_{i12} for group 1 parameter values and group 2 means
- ε_{i21} for group 2 parameter values and group 1 means
- ε_{i22} for group 2 parameter values and group 2 means.

If the member belongs to group 1, then ε_{i11} and ε_{i12} will be based on the member's observed promotion outcome, whereas ε_{i21} and ε_{i22} will be based on an imputed value of the promotion outcome. Here, for member *i*, $\varepsilon_{i11} - \varepsilon_{i12}$ equals the difference in the expected quality factor attributable to the difference between group means, given group 1 parameters; $\varepsilon_{i11} - \varepsilon_{i21}$ equals the difference in the expected quality factor due to differences in group parameters, given group 1 means; etc. Also, $\varepsilon_{i11} - \varepsilon_{i22}$ equals the difference in member *i*'s expected quality factor attributable to parameter differences and mean differences.

To apply these concepts, we ask how group 1 would have done in the context of group 2. For each member of group 1, we compute expected quality subject to the member's own group means and parameters and subject to group 2 means and parameters. Then, for this member,

$$q_{i11} - q_{i22} = \beta_1(x_i - \mu_1) - \beta_2(x_i - \mu_2) + \varepsilon_{i11} - \varepsilon_{i22}.$$

Averaging across group members we obtain

$$\overline{q}_{11} - \overline{q}_{22} = \beta_2(\mu_2 - \mu_1) + \overline{\varepsilon}_{11} - \overline{\varepsilon}_{22}.$$

It should be borne in mind that the values taken by the quality factor generally change over the course of the first term as promotion outcomes are realized. Hence, the group average value of the expected quality factor will vary with time. Thus, for comparisons of quality across groups, it may be helpful to pick a certain point—for example, the 36th month or the 48th month. The later in the term, the more information on promotion is available for estimating the quality factor.

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Appendix B

ANALYSIS TABLES

This appendix provides detailed tables to support the analysis in this report.

Table B.1

Army Estimates of Coefficient on AQFT for FY 1978–1984

	FY						
Occupation	1978	1979	1980	1981	1982	1983	1984
41	0.0070**	0.0042	0.0036	0.0098**	0.0175**	0.0074*	0.0067*
	(0.0020)	(0.0025)	(0.0037)	(0.0035)	(0.0043)	(0.0032)	(0.0033)
42						0.0032	
						(0.0025)	
43	0.0057**	0.0030	0.0065**	0.0134*	0.0068**	0.0049*	0.0111**
	(0.0020)	(0.0020)	(0.0021)	(0.0065)	(0.0016)	(0.0021)	(0.0020)
101		0.0037*	0.0071**	0.0067**	0.0104**	0.0085**	0.0086**
		(0.0015)	(0.0025)	(0.0017)	(0.0033)	(0.0024)	(0.0020)
121	0.0025			0.0046*	0.0058*		
	(0.0014)			(0.0019)	(0.0026)		
201	0.0082**	0.0005	0.0096**	0.0164**	0.0198**	0.0051**	0.0024
	(0.0022)	(0.0016)	(0.0029)	(0.0030)	(0.0029)	(0.0017)	(0.0017)
202	0.0057	0.0058*	0.0099**	0.2759**	0.0033	0.0082**	0.0075**
	(0.0031)	(0.0025)	(0.0024)	(0.0345)	(0.0017)	(0.0022)	(0.0022)
231	0.0634**			0.0523**	2.0869**	1.6597**	
	(0.0097)			(0.0128)	(0.1057)	(0.1051)	
250	0.0077**	0.0122**	0.0145**	0.0188**	0.0160**	0.0177**	0.0274
	(0.0019)	(0.0016)	(0.0028)	(0.0065)	(0.0040)	(0.0037)	(0.0167)
260	0.0060**	0.0096**	0.0070*		0.0130**	0.0088**	0.0053**
	(0.0018)	(0.0018)	(0.0029)		(0.0022)	(0.0022)	(0.0016)
300	0.0093**	0.0081**	0.0089**	0.0025	0.0082**	0.0090**	0.0111**
	(0.0018)	(0.0022)	(0.0027)	(0.0014)	(0.0019)	(0.0020)	(0.0018)
494			0.0051			0.0096**	
			(0.0032)			(0.0030)	
500	0.0092**	0.0081**	0.0077**	0.0146**	0.0154**	0.0255**	0.0227**
	(0.0019)	(0.0020)	(0.0016)	(0.0045)	(0.0020)	(0.0039)	(0.0037)
510	0.0090**	0.0082**	0.0076**		0.0165**	0.0169**	0.0262**
	(0.0022)	(0.0016)	(0.0017)		(0.0024)	(0.0020)	(0.0069)
551	0.0043**	0.0048*	0.0011	0.0175**	0.0153**	0.0054**	0.0093**
	(0.0016)	(0.0022)	(0.0044)	(0.0064)	(0.0056)	(0.0017)	(0.0016)
552	0.0027	0.0053**	0.0007	0.0103**	0.0191**	0.0105**	0.0141**
	(0.0014)	(0.0020)	(0.0016)	(0.0039)	(0.0055)	(0.0017)	(0.0020)
600	0.0075**	0.0085**	0.0093**	0.0087**	0.0074**	0.0101**	0.0116**
	(0.0012)	(0.0023)	(0.0019)	(0.0015)	(0.0023)	(0.0020)	(0.0019)
610	0.0020	0.0041	0.0090**	0.0108*	0.0152*	0.0208**	0.0096**
	(0.0013)	(0.0023)	(0.0032)	(0.0053)	(0.0063)	(0.0071)	(0.0029)
611	0.0017	0.0015	0.0045**	0.0100**	0.2623**	0.2992**	0.0016
	(0.0017)	(0.0023)	(0.0017)	(0.0029)	(0.0310)	(0.0283)	(0.0016)
621	0.0159**	0.0039	0.0028	0.3298**	0.0010	0.0002	0.0030
	(0.0029)	(0.0040)	(0.0031)	(0.0481)	(0.0016)	(0.0015)	(0.0043)
662	0.0034					0.0037	0.0036*
	(0.0018)					(0.0026)	(0.0015)
713		0.0051	0.0061			0.0130**	0.0102**
		(0.0028)	(0.0046)			(0.0029)	(0.0033)
800	0.0059**	0.0072	0.0044	0.0010	0.0010	0.0084**	0.0035*
	(0.0020)	(0.0132)	(0.0045)	(0.0019)	(0.0016)	(0.0023)	(0.0017)
811	0.0019	0.0055*	0.0002	0.4149**		0.0052	0.0090**
	(0.0014)	(0.0025)	(0.0021)	(0.1231)		(0.0042)	(0.0030)
821			0.0224			0.0018	0.0138**
			(0.0121)			(0.0027)	(0.0030)
830	0.0063**	0.0077**	0.0014		0.0098**	0.0083**	0.0139**
	(0.0024)	(0.0013)	(0.0015)		(0.0022)	(0.0022)	(0.0021)

NOTE: Standard errors in parentheses.
*Statistically significant at the 0.05 level.
**Statistically significant at the 0.01 level.

Table B.2

Army Estimates of Coefficient on AQFT for FY 1985–1992

	FY							
Occupation	1985	1986	1987	1988	1989	1990	1991	1992
41	0.0177*	0.1522**	0.0214**		0.0053	0.0014	0.0075**	0.0021
	(0.0075)	(0.0330)	(0.0027)		(0.0028)	(0.0021)	(0.0022)	(0.0040)
42								
43	0.0253**	0.4087**	0.0143*	0.0121**	0.0084**	0.0067**	0.0129**	
	(0.0065)	(0.0354)	(0.0069)	(0.0024)	(0.0019)	(0.0023)	(0.0029)	
101	0.0052**	0.0123**	0.0205**	0.0355**		0.0059		
	(0.0013)	(0.0046)	(0.0038)	(0.0106)		(0.0035)		
121								
201	0.0112**	0.1715**	0.0054*	0.0091**	0.0018	0.0001	0.0070*	0.0019
	(0.0028)	(0.0146)	(0.0023)	(0.0019)	(0.0020)	(0.0020)	(0.0029)	(0.0040)
202	0.0028	0.0033*	0.0143	0.0040				
	(0.0017)	(0.0015)	(0.0091)	(0.0031)				
231	0.0501**		0.0447**	0.0444**	0.0154**			
	(0.0178)		(0.0098)	(0.0097)	(0.0050)			
250	0.0371*	0.4920**	0.0137**	0.0104**	0.0085**	0.0069**	0.0067**	0.0127**
	(0.0146)	(0.0546)	(0.0045)	(0.0038)	(0.0019)	(0.0025)	(0.0019)	(0.0026)
260	0.0137**				0.0029	0.0190	0.0074*	
	(0.0048)				(0.0030)	(0.0150)	(0.0036)	
300	0.0124**	0.0103**	0.0121**	0.0114**	0.0053*	0.0025	0.0051	0.0092**
	(0.0018)	(0.0020)	(0.0043)	(0.0027)	(0.0021)	(0.0027)	(0.0030)	(0.0025)
494			0.0060	0.0073**				
			(0.0044)	(0.0025)				
500	0.0147**	0.0104**	0.0131**		0.3621**		0.0090**	0.0036
	(0.0023)	(0.0021)	(0.0020)		(0.0801)		(0.0034)	(0.0048)
510	0.0195**	0.0336**	0.0094**	0.0126**	0.0100		0.0060	0.0055
	(0.0043)	(0.0061)	(0.0023)	(0.0048)	(0.0097)		(0.0077)	(0.0037)
551	0.0203**	0.2148**	0.0127*	0.0096**	0.0069*	0.0070	0.0039	0.0037
	(0.0044)	(0.0200)	(0.0060)	(0.0023)	(0.0033)	(0.0169)	(0.0024)	(0.0026)
552	0.0189**	0.0136**	0.0135**	0.0098**	0.0050	0.0088**		
	(0.0068)	(0.0038)	(0.0041)	(0.0001)	(0.0030)	(0.0028)		
600	0.0204**	0.0130**	0.0220**	0.0096**	0.0085**			
	(0.0035)	(0.0021)	(0.0030)	(0.0031)	(0.0030)			
610	0.3153**	0.1280**	0.0257	0.0112**	0.0001	0.0044*	0.0092**	0.0023
	(0.0305)	(0.0285)	(0.0160)	(0.0037)	(0.0033)	(0.0021)	(0.0033)	(0.0168)
611	0.0121**	0.0170**	0.0138**	0.0033	0.0019	0.0041	0.0028	0.0036
	(0.0040)	(0.0038)	(0.0032)	(0.0021)	(0.0070)	(0.0023)	(0.0031)	(0.0027)
621	0.0048							
	(0.0029)							
662	0.0030*	0.1930**	0.0160	0.0163*	0.0036			0.0030
	(0.0014)	(0.0288)	(0.0100)	(0.0066)	(0.0026)			(0.0098)
713								
800	0.0010	0.0113	0.0273	0.0057*	0.0011	0.0062**	0.0029	0.0084**
	(0.0014)	(0.0070)	(0.0543)	(0.0027)	(0.0015)	(0.0022)	(0.0027)	(0.0021)
811	0.4618**	0.0220	0.0006	0.0443**	0.0033	0.0029	0.0090**	0.0026
	(0.0419)	(0.0124)	(0.0018)	(0.0109)	(0.0038)	(0.0113)	(0.0029)	(0.0046)
821	0.6470**	0.0198*	0.0057**		0.0027			0.0039
	(0.0793)	(0.0092)	(0.0019)		(0.0033)			(0.0033)
830	0.0117**	0.0138**	0.0223**	0.0139**	0.0124**	0.0073**	0.0072	0.0096*
	(0.0019)	(0.0024)	(0.0030)	(0.0020)	(0.0024)	(0.0010)	(0.0042)	(0.0047)

NOTE: Standard errors in parentheses.
*Statistically significant at the 0.05 level.
**Statistically significant at the 0.01 level.

Table B.3

Air Force Estimates of Coefficient on AQFT

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
510	0.0160**	0.0174**	0.0177**	0.0608**	0.0240**	0.0203**	0.0207**	0.0862**	0.0179**						
	(0.0027)	(0.0000)	(0.0000)	(0.0148)	(0.0041)	(0.0031)	(0.0028)	(0.0109)	(0.0035)						
551	0.0170*	0.0110**	0.0181**	0.0307**	0.0159**	0.0217**	0.0299**		0.0226**	0.0700**	0.0882**		0.0210**		
	(0.0073)	(0.0021)	(0.0036)	(0.0078)	(0.0034)	(0.0038)	(0.0048)		(0.0032)	(0.0091)	(0.0274)		(0.0063)		
600	0.0093**	0.0097	0.0144**	0.0153**	0.0110**	0.0624**	0.0215**			0.0207**	0.0142		0.0175*		0.0811**
	(0.0019)	(0.0061)	(0.0022)	(0.0030)	(0.0025)	(0.0000)	(0.0036)			(0.0034)	(0.0137)		(0.0073)		(0.0182)
800												0.0049			
												(0.0143)			
822	0.0109**	0.0085**	0.0183	0.0118		0.0173**	0.0453**								
	(0.0029)	(0.0030)	(0.0107)	(0.0064)		(0.0034)	(0.0091)								
830		0.0176**	0.0166**	0.0221**	0.0181**	0.0265**	0.0195**		0.0645**					0.0230**	
		(0.0029)	(0.0036)	(0.0055)	(0.0019)	(0.0044)	(0.0027)		(0.0160)					(0.0071)	

NOTE: Standard errors in parentheses.
*Statistically significant at the 0.05 level.
**Statistically significant at the 0.01 level.

Table B.4

Marine Corps Estimates of Coefficient on AQFT

	FY													
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1992
510	0.0132**	0.0108**	0.0119**	0.0476	0.0572**	0.0169**	0.0542**	0.0747**				0.0131**		
	(0.0021)	(0.0018)	(0.0023)	(0.0595)	(0.0184)	(0.0025)	(0.0061)	(0.0069)				(0.0045)		
551	0.0078**	0.0050**	0.0035		0.0201**	0.0177**	0.0197**				0.0119**			0.3847**
	(0.0025)	(0.0018)	(0.0038)		(0.0047)	(0.0029)	(0.0044)				(0.0026)			(0.0506)
600					0.0098**	0.0121**	0.0124**							
					(0.0033)	(0.0034)	(0.0023)							
602	0.0005													
	(0.0020)													
800			0.0058**				0.0104**							
			(0.0019)				(0.0026)							
811	0.0021	0.0075**	0.0245**	0.0234**	0.0152**	0.0393**	0.1251**	0.0442	0.0107**	0.0030	0.0051	0.0130**	0.0096**	0.0070
	(0.0041)	(0.0021)	(0.0062)	(0.0056)	(0.0000)	(0.0067)	(0.0242)	(0.0287)	(0.0038)	(0.0072)	(0.0096)	(0.0000)	(0.0035)	(0.0054)
822			0.0135**	0.0180**					0.0139**					
			(0.0026)	(0.0022)					(0.0053)					

NOTE: Standard errors in parentheses.
*Statistically significant at the 0.05 level.
**Statistically significant at the 0.01 level.

Table B.5

Percentage of Variation in Quality Index Attributable to Unobserved Ability: Army

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
41	92	98	96	82	43	95		39	0	53			100	95	99
42						99									
43	95	99	96	49	95	97	87	24	0	44	87	93	95	84	
101		98	90	94	86	92	94	97	79	56	11		97		
121	99			98	97										
201	88	100	90	59	49	97	99	77	0	97	93	100	100	96	100
202		97	91	0	99	94	95	99	99	62	99				
231	0			2	0	0		1		3	11	69			
250	91	80	66	32	54	44	21	7	0	83		92	94	96	84
260	96	92	96		81	91	97	65				99	31	97	
300	83	90	89	99	92	92		87	92	89	89	97		94	93
494			96			89				97	95				
500	89	93	93	69	76	45	54	86	93	89		0		94	99
510	89	92	92		68	72	27			93	88			98	98
551	98	98	100	63	46	97	93	47	0	75	93	96		99	
552	99	97	100	80	35	89	83	39	67	67	93	98	95		
600	92	88	87	91	95	92	88	58	87	65	92	93			
610	100	98	87	62	53	38	88	0	0	21	84		98	82	96
611	99	100	98	82	0	0	100	78	56	76	99	100	99	99	99
621	65	98	99	0	100	100		97							
662	99					99	99	99	0	46	33	99			
713		97	96			85	89								
800	96	97	97	100	100	95	99	100	76	9	98				93
811	100	97	100	0		95	90	0	26	100	1	99	93	93	
821						100	77	0	33	98		99			98
830		93	100		91	94	83	90	86	64	85	87		96	89

Table B.6

Percentage of Variation in Quality Index Attributable to Unobserved Ability: Air Force

	FY											
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
510	61			1		58	65	0	59			
551	33	84	47	23	64	54	30		55	1	0	
600	81	69	66	58			51			53	41	35
822	79	89	27			65						
830		64	51	40	64	41	63		0			

Table B.7

Percentage of Variation in Quality Index Attributable to Unobserved Ability: Marine Corps

	FY												
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990	1992
510	82	89	87	5	2	80	3	1					
551	90	98			42	79	71				91		0
600					95	92	90						
602	100												
800			97										
811	98	95		11			0		91	97		96	95
822			85	79					61				

Table B.8

Army Retains Soldiers with Lower Average AFQT

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
41	−3.1	−1.0	−1.2	−1.4	−3.7	−3.2		−4.2	−4.2	−3.1			−1.9	−1.5	−3.8
42						−4.2									
43	−1.1	−2.6	0.4	−1.4	−3.5	−4.5	−5.6	−4.6	−4.1	−5.5	−3.9	−3.4	−2.4	−2.7	
101		−4.1	−0.6	−1.7	−3.0	−1.9	−3.3	−3.4	−4.5	−2.9	−1.0		−2.2		
121	−4.7			−2.1	−2.4										
201	−3.8	−4.8	−1.8	−1.1	−3.0	−5.3	−4.8	−5.1	−4.5	−3.9	−3.6	−2.7	−3.5	−4.1	−2.8
202	−2.3	−1.4	−1.3	−2.2	−2.5	−5.4	−4.6	−6.6	−6.1	−5.9	−3.7				
231	−2.9			−3.0	−2.0	−0.9		−2.6		−1.0	−0.9	−2.6			
250	−0.2	0.3	−0.5	−2.0	−1.4	−5.4	−6.3	−5.3	−4.7	−2.9		−4.0	−3.5	−2.6	−3.3
260	−1.1	−0.7	0.3		−4.6	−5.8	−5.8	−6.3				−4.6	−3.4	−2.2	
300	−4.8	−5.7	−3.6	−5.4	−3.3	−2.1		−4.6	−4.3	−4.8	−3.2	−3.0		−4.5	−2.4
494			−1.8			−4.9				−3.5	−4.1				
500	−4.2	−2.1	−1.7	−2.5	−3.7	−5.5	−3.9	−2.0	−2.9	−3.0		−4.2		−1.4	−3.0
510	−3.4	−4.7	−2.0		−6.6	−6.8	−4.0			−4.1	−3.2			−1.4	−1.1
551	−2.2	−1.6	−1.3	0.2	−2.5	−3.9	−5.7	−6.2	−6.6	−5.8	−4.2	−3.9		−3.4	
552	−4.4	−4.0	−2.3	−1.9	−5.3	−6.4	−7.5	−6.7	−6.3	−5.3	−3.8	−4.8	−5.1		
600	−6.0	−2.5	−2.3	−4.5	−1.7	−0.6	−2.8	−2.6	−2.3	−1.6	−2.2	−1.8			
610	−4.4	−2.1	−0.3	−1.6	−5.1	−3.1	−3.7	−3.1	−2.9	−2.9	−2.0		−3.3	−1.1	−1.5
611	−3.1	−1.9	−1.5	−0.8	−1.3	1.6	−2.5	−1.2	−3.0	−2.2	−3.0	−3.5	−0.6	0.5	0.8
621	−1.5	−1.8	−0.8	−1.6	−4.6	−5.4		−3.8							
662	−1.7					0.0	−4.9	−4.6	−4.5	−3.0	−2.0	−1.7			
713		0.5	−0.3			−1.4	−0.9								
800	−3.8	0.5	2.0	−0.6	−3.7	−4.9	−4.1	−5.4	−6.0	−5.0	−2.6				−2.6
811	−3.6	−2.4	−1.9	−2.4		−4.0	−5.0	−5.1	−4.4	−5.3	−5.4	−2.4	−3.0	−2.1	
821						−3.5	−4.1	−6.6	−4.1	−6.0		−3.7			−2.6
830		−2.1	−2.3		−1.4	−3.8	−2.9	−2.2	−2.6	−1.1	−0.4	−2.7		2.0	−0.3

NOTE: Number gives difference in mean AFQT between retained and separated personnel. Numbers in shaded cells indicate lower mean AFQT retained, and numbers in white cells indicate higher mean AFQT retained. Blank cells indicate there is no corresponding quality estimate.

Table B.9

Army Retains Soldiers with Higher Average Quality

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
41	0.29	0.38	0.24	0.26	0.16	0.28		0.13	−0.61	0.21			0.36	0.27	0.17
42						0.34									
43	0.30	0.44	0.46	0.23	0.34	0.27	0.24	0.01	−1.66	0.09	0.28	0.20	0.28	0.20	
101		0.38	0.26	0.32	0.16	0.18	0.14	0.29	0.14	0.16	0.07		0.25		
121	0.33			0.33	0.33										
201	0.31	−0.27	0.33	0.24	0.15	0.18	0.16	0.12	−0.76	0.29	0.23	0.26	−0.24	0.20	0.16
202	0.24	0.42	0.45	−0.59	0.30	0.17	0.14	0.28	0.22	0.05	0.30				
231	−0.17			−0.09	−4.12	−1.51		−0.10		0.03	0.05	−0.01			
250	0.33	0.40	0.41	0.22	0.26	0.11	−0.04	−0.10	−2.30	0.26		0.18	0.28	0.22	0.21
260	0.28	0.34	0.35		0.20	0.16	0.14	0.03				0.16	0.00	0.20	
300	0.18	0.27	0.31	0.27	0.24	0.29		0.18	0.25	0.25	0.18	0.25		0.14	0.24
494			0.31			0.22				0.30	0.29				
500	0.16	0.34	0.39	0.22	0.18	0.05	0.09	0.22	0.21	0.19		−1.53		0.21	0.20
510	0.16	0.23	0.28		0.05	0.01	−0.03			0.15	0.20			0.22	0.26
551	0.34	0.34	−0.25	−0.08	0.10	0.21	0.20	0.03	−1.40	0.12	0.26	0.18		0.26	
552	0.29	0.29	0.41	0.23	0.08	0.14	0.08	0.01	0.08	0.09	0.17	0.22	0.22		
600	0.20	0.25	0.29	0.18	0.23	0.12	0.13	0.14	0.16	0.13	0.17	0.20			
610	0.39	0.44	0.38	0.16	0.14	0.13	0.25	−0.98	−0.35	0.05	0.22		0.24	0.13	0.08
611	0.30	0.33	0.45	0.34	−0.34	0.50	0.26	0.25	0.06	0.24	0.21	−0.25	0.25	0.20	0.20
621	0.19	−0.22	0.38	−0.53	0.30	0.23		0.26							
662	0.26					0.28	0.21	0.30	−0.87	0.05	0.05	0.29			
713		0.50	0.39			0.31	0.39								
800	0.28	0.53	0.34	−0.43	0.37	0.28	0.35	0.37	−0.17	−0.14	0.33				0.28
811	0.28	0.33	−0.39	−0.99		−0.09	−0.08	−2.36	−0.03	0.30	−0.20	0.28	−0.09	0.27	
821						0.35	0.31	−4.29	−0.07	0.30		0.23			0.18
830		0.24	0.23		0.19	0.06	0.12	0.17	0.17	0.18	0.24	0.27		0.25	0.23

NOTE: Number gives difference in mean quality index between retained and separated personnel. Numbers in shaded cells indicate lower mean quality retained, and numbers in white cells indicate higher mean quality retained. Blank cells indicate there is no quality estimate, due either to small sample size or failure of convergence of the maximum likelihood algorithm.

Table B.10

Air Force Retains Airmen with Lower Average AFQT

	FY											
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
510	−0.7			−2.3		−2.3	−1.0	−2.0	−3.4			
551	−1.0	−1.6	−1.7	−1.5	−1.9	−2.1	−0.9		−2.1	−0.5	−1.1	
600	−0.5	−0.6	−0.6	0.3			−0.1			−0.3	−1.5	−0.6
822	1.3	−2.2	−3.0			0.7						
830		0.2	1.9	1.2	−0.7	0.7	−0.6		−0.5			

NOTE: Number gives difference in mean AFQT between retained and separated personnel. Numbers in shaded cells indicate lower mean quality retained, and numbers in white cells indicate higher mean quality retained. Blank cells indicate there is no corresponding quality estimate.

Table B.11

Air Force Retains Airmen with Higher Average Quality

	FY											
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
510	0.15			−0.10		0.10	0.12	−0.16	0.03			
551	0.08	0.23	0.12	0.09	0.10	0.11	0.08		0.08	−0.01	−0.09	
600	0.19	0.13	0.17	0.15			0.12			0.10	0.04	0.04
822	0.24	0.17	0.03			0.22						
830		0.21	0.18	0.14	0.14	0.11	0.12		−0.02			

NOTE: Number gives difference in mean quality index between retained and separated personnel. Numbers in shaded cells indicate lower mean quality retained, and numbers in white cells indicate higher mean quality retained. Blank cells indicate there is no quality estimate, due either to small sample size or failure of convergence of the maximum likelihood algorithm.

Table B.12

Marine Corps Retains Marines with Lower Average AFQT

	FY												
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990	1992
510	−2.3	−2.3	−2.9	1.0	−3.8	−2.8	−4.4	−4.4					
551	−1.2	−2.9			1.3	−3.6	−3.6				−3.9		−2.6
600					0.2	−4.4	−1.5						
602	−1.9												
800			−1.7										
811	−3.2	−0.6		−0.5			−3.6		−3.6	−1.4		−0.5	−1.0
822			−0.2	−0.8					−1.9				

NOTE: Number gives difference in mean AFQT between retained and separated personnel. Numbers in shaded cells indicate lower mean quality retained, and numbers in white cells indicate higher mean quality retained. Blank cells indicate there is no corresponding quality estimate.

Table B.13

Marine Corps Retains Marines with Higher Average Quality

	FY												
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990	1992
510	0.36	0.60	0.46	0.18	−0.12	0.34	−0.15	−0.24					
551	0.38	0.58			0.26	0.34	0.29				0.37		−0.99
600					0.42	0.28	0.28						
602	0.24												
800			0.57										
811	0.40	0.67		0.11			−0.43		0.30	0.21		0.45	0.32
822			0.51	0.38					0.20				

NOTE: Number gives difference in mean quality index between retained and separated personnel. Numbers in shaded cells indicate lower mean quality retained, and numbers in white cells indicate higher mean quality retained. Blank cells indicate there is no quality estimate, either due to small sample size or failure of convergence of the maximum likelihood algorithm.

Table B.14

Coefficients on Quality Index from Retention Logits: Army

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
41	1.7720**	1.5388**	3.3734**	1.3736**	2.4692**	0.8893**		2.8691**	8.0631**	1.5596**			1.1640**	1.0266**	2.2413**
42						1.1083**									
43	1.1979**	1.7834**	1.8941**	3.7370**	1.0804**	0.8216**	0.9020**	1.6364**	17.7047**	3.2906**	0.9770**	0.7861**	1.1579**	0.9647**	
101		0.9536**	1.1590**	0.9628**	0.7720**	0.6827**	0.4829**	0.8004**	1.0682**	1.3235**	3.3795**		0.7937**		
121	0.7777**			0.9280**	0.8797**										
201	1.4055**	−0.8839**	1.3856**	1.7590**	1.3860**	0.6301**	0.5376**	1.1455**	7.5598**	0.8473**	0.7842**	0.8639**	−0.7250**	0.7451**	0.6125**
202	1.2712**	1.3984**	1.8241**	52.1989**	0.9069**	0.6424**	0.4881**	0.7904**	0.5980**	1.3768**	0.9685**				
231	7.9545**			3.2338**	86.4303**	55.6945**		5.4824**		3.8058**	1.9611**	0.2415			
250	0.9996**	1.4466**	2.4806**	3.2008**	2.2296**	1.7358**	1.4819**	2.2463**	19.9222**	0.9706**		0.7062**	1.1485**	0.8127**	1.1232**
260	0.7464**	0.8587**	1.1444**		0.9041**	0.6834**	0.4562**	0.9577**				0.6005**	1.8162**	0.6852**	
300	0.9144**	1.0493**	1.2847**	0.8879**	0.8660**	0.9187**		0.6435**	0.8264**	0.9058**	0.7484**	0.8888**		1.7679**	1.0945**
494			1.4207**			0.8343**				1.0233**	0.8625**				
500	0.6636**	1.1241**	1.2953**	1.5414**	0.8378**	0.9949**	0.8298**	0.7193**	0.7213**	0.6717**		35.2695**		0.7498**	0.7333**
510	0.5914**	0.8531**	0.9884**		0.6851**	0.4580**	0.8895**			0.6435**	0.8974**			0.7373**	0.7863**
551	0.8579**	1.1704**	−2.8559**	−1.0871**	2.6813**	0.6326**	0.6668**	1.2629**	15.3860**	1.3255**	0.8734**	0.7232**		0.9371**	
552	0.7314**	0.8753**	1.2126**	2.1982**	2.6771**	0.5969**	0.5582**	1.8612**	1.7595**	1.7083**	0.6042**	0.8949**	0.7750**		
600	0.5910**	0.9103**	1.1452**	0.5869**	0.6924**	0.3393**	0.4583**	1.0075**	0.5541**	0.5705**	0.6241**	0.7338**			
610	0.9633**	1.5272**	2.4826**	2.4868**	2.0412**	1.9888**	1.3148**	20.1703**	9.4743**	2.2913**	1.2767**		0.8220**	1.5042**	2.8335**
611	1.2900**	1.4040**	1.6096**	1.9469**	39.9850**	26.7405**	0.6532**	1.6571**	0.8781**	1.5512**	0.6325**	−0.7256**	0.7906**	0.6340**	0.6633**
621	1.5790**	−0.9851**	1.6628**	−29.2620**	0.8676**	0.6255**		1.1930**							
662	0.6283**					0.7262**	0.5846**	0.7398**	8.2767**	1.2949**	2.4588**	0.8726**			
713		1.5776**	1.4632**			1.0601**	1.6797**								
800	0.8060**	1.3589**	3.8740**	−1.3219**	1.1464**	0.9013**	0.9654**	0.9824**	−0.8099**	0.0894	1.0061**				1.2899**
811	0.6873**	1.0185**	−1.3637**	−125.2387**		−0.4387**	−0.1435	24.6832**	1.2019**	0.8186**	5.9682**	0.9782**	−3.1096**	0.9971**	
821						0.9967**	1.8921**	34.1811**	0.2927	0.8548**		0.8755**			0.9004**
830		0.6380**	0.7143**		0.7115**	0.2767**	0.5289**	0.5727**	0.6639**	0.9078**	0.8210**	1.2045**		0.9140**	1.6677**

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

Table B.15

Coefficients on AFQT from Retention Logits: Army

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
41	–0.0214**	–0.0099**	–0.0166**	–0.0186**	–0.0538**	–0.0142**		–0.0659**	–1.2407**	–0.0439**			–0.0085**	–0.0130**	–0.0182**
42						–0.0158**									
43	–0.0097**	–0.0137**	–0.0123**	–0.0559**	–0.0160**	–0.0155**	–0.0237**	–0.0548**	–7.2491**	–0.0647**	–0.0237**	–0.0166**	–0.0156**	–0.0209**	
101		–0.0106**	–0.0093**	–0.0100**	–0.0156**	–0.0111**	–0.0136**	–0.0149**	–0.0284**	–0.0383**	–0.1243**		–0.0129**		
121	–0.0092**			–0.0091**	–0.0118**										
201	–0.0198**	–0.0111**	–0.0190**	–0.0328**	–0.0359**	–0.0180**	–0.0143**	–0.0270**	–1.3103**	–0.0175**	–0.0194**	–0.0097**	–0.0120**	–0.0199**	–0.0131**
202	–0.0125**	–0.0133**	–0.0238**	–14.4108**	–0.0105**	–0.0212**	–0.0189**	–0.0222**	–0.0210**	–0.0409**	–0.0188**				
231	–0.5102**			–0.1778**	–180.379**	–92.4409**		–0.2867**		–0.1763**	–0.0916**	–0.0143**			
250	–0.0083**	–0.0178**	–0.0401**	–0.0666**	–0.0401**	–0.0427**	–0.0561**	–0.0982**	–9.8153**	–0.0224**		–0.0169**	–0.0186**	–0.0137**	–0.0258**
260	–0.0072**	–0.0108**	–0.0070*		–0.0231**	–0.0210**	–0.0175**	–0.0311**				–0.0189**	–0.0482**	–0.0149**	
300	–0.0168**	–0.0203**	–0.0198**	–0.0131**	–0.0159**	–0.0147**		–0.0222**	–0.0233**	–0.0267**	–0.0195**	–0.0152**		–0.0272**	–0.0201**
494			–0.0122**			–0.0192**				–0.0175**	–0.0178**				
500	–0.0156**	–0.0149**	–0.0150**	–0.0298**	–0.0227**	–0.0407**	–0.0302**	–0.0180**	–0.0201**	–0.0207**		–12.7878**		–0.0136**	–0.0158**
510	–0.0125**	–0.0184**	–0.0122**		–0.0271**	–0.0254**	–0.0361**			–0.0230**	–0.0261**			–0.0119**	–0.0094*
551	–0.0104**	–0.0125**	–0.0047	0.0199**	–0.0497**	–0.0161**	–0.0249**	–0.0443**	–3.3286**	–0.0370**	–0.0246**	–0.0217**		–0.0186**	
552	–0.0130**	–0.0168**	–0.0074**	–0.0301**	–0.0665**	–0.0234**	–0.0297**	–0.0556**	–0.0484**	–0.0433**	–0.0210**	–0.0275**	–0.0293**		
600	–0.0139**	–0.0122**	–0.0157**	–0.0144**	–0.0097**	–0.0050	–0.0133**	–0.0289**	–0.0148**	–0.0178**	–0.0133**	–0.0116**			
610	–0.0126**	–0.0143**	–0.0248**	–0.0319**	–0.0453**	–0.0511**	–0.0260**	–6.3697**	–1.2232**	–0.0704**	–0.0227**		–0.0152**	–0.0182**	–0.0121**
611	–0.0087**	–0.0068**	–0.0123**	–0.0233**	–10.4923**	–7.9977**	–0.0090**	–0.0246**	–0.0247**	–0.0300**	–0.0123**	–0.0097**	–0.0056	–0.0001	0.0001
621	–0.0300**	–0.0032	–0.0095**	9.6436**	–0.0146**	–0.0168**		–0.0194**							
662	–0.0056					–0.0026	–0.0168**	–0.0162**	–1.6133**	–0.0308**	–0.0478**	–0.0094**			
713		–0.0084*	–0.0108**			–0.0192**	–0.0211**								
800	–0.0123**	–0.0082**	–0.0069*	–0.0003	–0.0122**	–0.0225**	–0.0161**	–0.0178**	–0.0104**	–0.0187*	–0.0152**				–0.0210**
811	–0.0101**	–0.0130**	–0.0065*	51.9543**		–0.0098**	–0.0169**	–11.4150**	–0.0417**	–0.0209**	–0.2850**	–0.0115**	–0.0015	–0.0166**	
821						–0.0160**	–0.0406**	–22.1338**	–0.0213**	–0.0282**		–0.0182**			–0.0139**
830		–0.0095**	–0.0060**		–0.0113**	–0.0145**	–0.0164**	–0.0143**	–0.0185**	–0.0246**	–0.0132**	–0.0256**		0.0035	–0.0181**

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

Table B.16

Coefficients on Quality Index from Retention Logits: Air Force

	FY											
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
510	0.9836**			3.3705**		1.1327**	0.7220**	3.6298**	0.8313**			
551	1.4987**	1.1777**	1.6964**	1.5827**	0.9211**	1.1546**	0.9708**		0.8685**	2.5918**	2.2336*	
600	1.0345**	1.5559**	1.1730**	1.5200**			0.9403**			0.8705**	2.5903**	1.5938**
822	1.2333**	0.8407**	3.5924**			1.3832**						
830		1.1927**	1.5000**	1.0588**	0.8403**	0.6087**	0.6700**		5.9046**			

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

Table B.17

Coefficients on AFQT from Retention Logits: Air Force

	FY											
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
510	–0.0171**			–0.2124**		–0.0318**	–0.0189**	–0.3205**	–0.0288**			
551	–0.0273**	–0.0171**	–0.0353**	–0.0519**	–0.0201**	–0.0327**	–0.0319**		–0.0280**	–0.1843**	–0.2023*	
600	–0.0105**	–0.0171**	–0.0183**	–0.0220**			–0.0207**			–0.0193**	–0.0437**	–0.0311**
822	–0.0103**	–0.0131**	–0.0770**			–0.0215**						
830		–0.0207**	–0.0201**	–0.0201**	–0.0177**	–0.0143**	–0.0151**		–0.3829**			

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

Table B.18

Coefficients on Quality Index from Retention Logits: Marine Corps

	FY												
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990	1992
510	1.0775**	1.5567**	1.4089**	3.2109**	6.4053**	1.0479**	4.4273**	4.6847**					
551	1.6273**	1.2924**			2.2666**	0.9887**	1.3954**				1.2096**		45.5574**
600					0.8213**	0.8342**	0.7851**						
602	0.5290**												
800			1.3003**										
811	2.3299**	1.7174**		6.1505**			18.6975**		1.3363**	2.8972**		1.3892**	2.2694**
822			1.3551**	1.0340**					3.1144**				

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

Table B.19

Coefficients on AFQT from Retention Logits: Marine Corps

	FY												
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990	1992
510	–0.0195**	–0.0252**	–0.0255**	–0.1503**	–0.3815**	–0.0286**	–0.2614**	–0.3696**					
551	–0.0155**	–0.0148**			–0.0436**	–0.0302**	–0.0408**				–0.0309**		–17.5420**
600					–0.0079	–0.0265**	–0.0154**						
602	–0.0039												
800			–0.0133**										
811	–0.0176**	–0.0169**		–0.1492**			–2.3590**		–0.0333**	–0.0183**		–0.0164*	–0.0230**
822			–0.0205**	–0.0220**					–0.0547**				

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

Table B.20

Fraction Promoted to E-5 in the First Term: Army

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
41	0.18	0.11	0.10	0.09	0.11	0.18	0.17	0.14	0.14	0.10	0.03	0.04	0.04	0.03	0.01
42	0.08	0.00	0.14	0.17	0.22	0.18	0.10	0.02	0.07	0.14	0.12	0.12	0.17	0.13	0.09
43	0.17	0.10	0.10	0.16	0.16	0.07	0.07	0.08	0.09	0.08	0.07	0.04	0.05	0.05	0.04
101	0.21	0.22	0.21	0.12	0.14	0.14	0.13	0.11	0.08	0.09	0.08	0.10	0.06	0.06	0.03
102	0.49	0.45	0.47	0.39	0.30	0.30	0.32	0.26	0.22	0.26	0.17	0.12	0.10	0.10	0.14
121	0.31	0.25	0.22	0.21	0.21	0.16	0.12	0.08	0.10	0.14	0.10	0.08	0.07	0.06	0.03
201	0.25	0.22	0.17	0.17	0.15	0.12	0.07	0.10	0.07	0.05	0.04	0.04	0.04	0.04	0.06
202	0.19	0.15	0.11	0.18	0.23	0.26	0.12	0.02	0.02	0.04	0.04	0.05	0.07	0.07	0.05
231	0.61	0.59	0.61	0.47	0.40	0.29	0.34	0.35	0.41	0.38	0.29	0.17	0.21	0.33	0.30
232	0.58	0.75	0.64	0.44	0.46	0.49	0.59	0.60	0.55	0.43	0.27	0.19	0.26	0.30	0.27
243	0.41	0.54	0.51	0.54	0.60	0.65	0.61	0.43	0.55	0.43	0.33	0.28	0.36	0.52	0.34
250	0.29	0.20	0.19	0.21	0.28	0.19	0.14	0.12	0.15	0.10	0.10	0.08	0.07	0.07	0.07
260	0.07	0.07	0.06	0.06	0.04	0.09	0.09	0.03	0.02	0.02	0.00	0.03	0.03	0.04	0.06
300	0.21	0.14	0.07	0.05	0.08	0.09	0.05	0.04	0.04	0.06	0.04	0.08	0.07	0.06	0.07
412	0.20	0.24	0.14	0.21	0.12	0.07	0.09	0.11	0.15	0.20	0.12	0.09	0.18	0.25	0.14
494	0.26	0.22	0.20	0.29	0.33	0.30	0.28	0.22	0.15	0.11	0.13	0.10	0.15	0.23	0.11
500	0.24	0.25	0.22	0.14	0.14	0.17	0.17	0.10	0.06	0.07	0.07	0.08	0.09	0.13	0.15
510	0.08	0.05	0.04	0.02	0.04	0.08	0.04	0.04	0.02	0.02	0.03	0.05	0.06	0.07	0.12
551	0.08	0.02	0.02	0.02	0.02	0.08	0.10	0.08	0.07	0.04	0.04	0.03	0.02	0.02	0.03
552	0.06	0.05	0.04	0.06	0.05	0.08	0.07	0.06	0.03	0.06	0.04	0.11	0.05	0.05	0.03
600	0.23	0.18	0.16	0.14	0.12	0.17	0.20	0.17	0.10	0.19	0.26	0.24	0.17	0.17	0.10
610	0.21	0.17	0.13	0.11	0.17	0.19	0.16	0.08	0.10	0.10	0.04	0.07	0.05	0.02	0.01
611	0.15	0.13	0.14	0.16	0.13	0.17	0.15	0.10	0.08	0.06	0.04	0.07	0.08	0.10	0.07
612	0.16	0.16	0.08	0.04	0.15	0.33	0.20	0.06	0.04	0.07	0.06	0.09	0.05	0.04	0.07
621	0.04	0.04	0.03	0.02	0.04	0.09	0.12	0.09	0.09	0.09	0.05	0.05	0.02	0.04	0.03
643	0.21	0.13	0.09	0.11	0.10	0.13	0.07	0.03	0.02	0.02	0.02	0.06	0.06	0.10	0.09
645	0.06	0.06	0.06	0.09	0.06	0.06	0.04	0.04	0.04	0.05	0.05	0.03	0.02	0.03	0.02
662	0.05	0.02	0.06	0.06	0.12	0.16	0.16	0.08	0.03	0.03	0.02	0.05	0.02	0.02	0.01
712	0.22	0.11	0.14	0.20	0.27	0.23	0.16	0.04	0.06	0.10	0.02	0.07	0.06	0.12	0.12
713	0.21	0.22	0.19	0.21	0.22	0.23	0.17	0.07	0.06	0.10	0.09	0.07	0.04	0.11	0.08
800	0.12	0.09	0.06	0.07	0.10	0.09	0.06	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02
811	0.06	0.01	0.02	0.01	0.01	0.03	0.06	0.05	0.05	0.03	0.02	0.04	0.03	0.06	0.03
821	0.02	0.02	0.02	0.07	0.14	0.17	0.17	0.04	0.02	0.01	0.01	0.04	0.02	0.06	0.05
830	0.05	0.02	0.03	0.04	0.07	0.13	0.10	0.10	0.07	0.08	0.12	0.13	0.07	0.12	0.20
911	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.11	0.04	0.00	0.00	0.00

NOTE: Light gray cells correspond to those samples with fewer than 1,000 observations. Darker gray cells correspond to those samples where we were unable to estimate the quality model.

Table B.21

Fraction Promoted to E-5 in the First Term: Air Force

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
100	0.00														
510	0.09	0.07	0.05	0.05	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
551	0.11	0.05	0.05	0.05	0.03	0.04	0.03	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
600	0.08	0.06	0.04	0.03	0.03	0.05	0.04	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
610	0.06	0.05	0.03	0.02	0.02	0.03	0.02	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00
621	0.07	0.06	0.03	0.02	0.01	0.03	0.02	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01
800	0.07	0.05	0.03	0.03	0.02	0.03	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00
811	0.07	0.06	0.02	0.02	0.02	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
822	0.10	0.05	0.03	0.03	0.02	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
830	0.08	0.05	0.04	0.03	0.03	0.04	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: Light gray cells correspond to those samples with fewer than 1,000 observations. Darker gray cells correspond to those samples where we were unable to estimate the quality model.

Table B.22

Fraction Promoted to E-5 in the First Term: Marine Corps

	FY														
Occupation	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
70	0.00														
101	0.70	0.65	0.56	0.32	0.20	0.14	0.08	0.04	0.04	0.16	0.21	0.13	0.17	0.13	0.14
102	0.47	0.58	0.26	0.31	0.14	0.19	0.10	0.03	0.00	0.00	0.03	0.03	0.09	0.50	0.43
198	0.76	0.68	0.66	0.61	0.43	0.17	0.23	0.39	0.18	0.30	0.30	0.23	0.17	0.32	0.56
201	0.62	0.41	0.38	0.20	0.27	0.25	0.29	0.33	0.27	0.00	0.29	0.60	0.50	0.10	0.33
222	0.41	0.33	0.15	0.11	0.15	0.20	0.11	0.09	0.28	0.50	0.25	0.10	0.03	0.05	0.08
232	0.50	0.83	0.79	0.37	0.40	0.27	0.31	0.24	0.41	0.21	0.08	0.09	0.23	0.47	0.43
300	0.00	0.00	0.00												
495	0.17	0.09	0.01	0.07	0.01	0.03	0.06	0.07	0.01	0.04	0.02	0.09	0.04	0.12	0.16
510	0.31	0.19	0.10	0.08	0.06	0.07	0.03	0.02	0.01	0.01	0.01	0.01	0.03	0.06	0.10
531	0.40	0.25	0.18	0.26	0.19	0.26	0.11	0.10	0.04	0.06	0.03	0.00	0.02	0.17	0.24
551	0.34	0.18	0.10	0.09	0.06	0.04	0.03	0.04	0.03	0.02	0.01	0.01	0.05	0.04	0.05
553	0.13	0.19	0.04	0.00	0.01	0.10	0.00	0.03	0.01	0.01	0.01	0.00	0.01	0.02	0.03
600	0.32	0.24	0.16	0.09	0.07	0.03	0.04	0.03	0.07	0.10	0.09	0.11	0.20	0.18	0.25
601	0.34	0.25	0.12	0.07	0.09	0.04	0.03	0.03	0.02	0.02	0.06	0.07	0.12	0.13	0.18
602	0.40	0.33	0.24	0.13	0.07	0.07	0.03	0.03	0.03	0.02	0.09	0.09	0.23	0.34	0.43
645	0.36	0.35	0.15	0.16	0.15	0.01	0.02	0.03	0.01	0.02	0.01	0.04	0.04	0.04	0.04
646	0.34	0.27	0.10	0.06	0.05	0.01	0.04	0.03	0.01	0.01	0.02	0.03	0.01	0.06	0.11
720	0.21	0.11	0.08	0.08	0.05	0.02	0.04	0.03	0.00	0.01	0.00	0.06	0.13	0.10	0.03
800	0.12	0.08	0.03	0.03	0.03	0.02	0.01	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.03
811	0.09	0.05	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.02	0.04
821	0.19	0.13	0.10	0.05	0.03	0.04	0.01	0.02	0.02	0.02	0.01	0.05	0.03	0.01	0.05
822	0.16	0.08	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.03
830	0.36	0.23	0.08	0.14	0.14	0.15	0.10	0.03	0.02	0.01	0.06	0.08	0.05	0.05	0.03

NOTE: Light gray cells correspond to those samples with fewer than 1,000 observations. Darker gray cells correspond to those samples where we were unable to estimate the quality model.

Appendix C

PARAMETER ESTIMATES

The following pages present tables with the maximum likelihood parameter estimates for the model described in the main text. Standard errors are in parentheses, a single asterisk is used to denote that a coefficient is significant at the 5-percent level, and a double asterisk is used to denote that a coefficient is significant at the 1-percent level.

Table C.1

Parameter Estimates for Army

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
101	1979	0.0037*	1.3922**	0.3680**	18.8737**	1.7075**	0.2940*	0.0274**	9.9877**	1.0045**
		(0.0015)	(0.1054)	(0.0350)	(0.4501)	(0.1138)	(0.1154)	(0.0025)	(0.4097)	(0.3425)
101	1980	0.0071**	0.8131**	0.1535**	16.6252**	1.3343**	0.0604	0.0339**	11.0508**	2.0884**
		(0.0025)	(0.1423)	(0.0153)	(0.4247)	(0.1267)	(0.2121)	(0.0048)	(1.0516)	(0.3931)
101	1981	0.0067**	1.3187**	0.3702**	23.0011**	2.4582**	0.2787	0.0163**	6.8949**	1.1844**
		(0.0017)	(0.0600)	(0.0248)	(0.3626)	(0.0935)	(0.1577)	(0.0021)	(0.5270)	(0.3040)
101	1982	0.0104**	0.8122**	0.5656**	22.6582**	2.6901**	0.8451**	0.0124**	10.9135**	2.2990**
		(0.0033)	(0.1933)	(0.1425)	(0.7526)	(0.1208)	(0.2145)	(0.0019)	(1.3476)	(0.5312)
101	1983	0.0085**	0.9910**	0.8749**	23.5513**	2.8424**	0.3843**	0.0156**	12.0859**	2.5198**
		(0.0024)	(0.1726)	(0.1165)	(0.2315)	(0.1716)	(0.1377)	(0.0024)	(1.6038)	(0.6520)
101	1984	0.0086**	1.1796**	0.5860**	21.5420**	2.8470**	0.3833**	0.0170**	13.4651**	3.3818**
		(0.0020)	(0.0779)	(0.0405)	(0.4244)	(0.1085)	(0.1065)	(0.0028)	(1.8509)	(0.7571)
101	1985	0.0052**	1.3586**	0.3787**	20.9664**	2.8165**	0.7207**	0.0098**	7.5597**	1.0313**
		(0.0013)	(0.0179)	(0.0188)	(0.3606)	(0.0761)	(0.1153)	(0.0013)	(0.7286)	(0.3043)
101	1986	0.0123**	0.3708**	0.1655**	16.1151**	2.6764**	2.3127	0.0155	32.8720**	5.3461**
		(0.0046)	(0.0882)	(0.0169)	(0.7819)	(0.1986)	(1.7797)	(0.0087)	(7.0616)	(1.7053)
101	1987	0.0205**	0.3267**	0.1830**	17.5619**	2.9516**	1.6429**	0.0069**	16.9542**	2.9014**
		(0.0038)	(0.0901)	(0.0173)	(0.7055)	(0.1758)	(0.3573)	(0.0017)	(1.7250)	(0.3277)
101	1988	0.0355**	0.2500**	0.2023**	19.7011**	3.3503**	0.2500	0.0070**	9.3370**	0.0762
		(0.0106)	(0.0671)	(0.0149)	(0.5838)	(0.1703)	(0.1984)	(0.0009)	(0.3377)	(0.0744)
101	1990	0.0059	1.1535**	0.5603**	24.9736**	2.7027**	0.6167	0.0078**	15.0008**	2.1298**
		(0.0035)	(0.4088)	(0.1468)	(0.3414)	(0.3174)	(0.3252)	(0.0023)	(1.7675)	(0.8073)
121	1978	0.0025	1.4271**	0.3850**	19.7066**	1.5522**	0.5428**	0.0383**	8.7927**	0.9807**
		(0.0014)	(0.1554)	(0.0415)	(0.4135)	(0.0877)	(0.1291)	(0.0034)	(0.3175)	(0.1410)
121	1981	0.0046*	1.3595**	0.3478**	22.6627**	2.3737**	0.3292*	0.0285**	8.3060**	0.8055**
		(0.0019)	(0.2098)	(0.0901)	(0.8878)	(0.1268)	(0.1497)	(0.0028)	(0.3415)	(0.1376)
121	1982	0.0058*	1.2467**	0.5194**	22.2715**	2.3375**	0.9018**	0.0165**	6.3647**	0.5432
		(0.0026)	(0.3282)	(0.1823)	(0.8915)	(0.1984)	(0.2408)	(0.0023)	(0.7199)	(0.3249)
201	1978	0.0082**	0.6629**	0.1893**	17.3085**	1.6285**	0.8923**	0.0312**	8.8918**	1.1502**
		(0.0022)	(0.1657)	(0.0289)	(0.7619)	(0.1738)	(0.2251)	(0.0028)	(0.4108)	(0.1377)
201	1979	0.0005	–1.0105	0.2069**	16.3738**	1.3285**	0.0121	0.0339**	9.7151**	1.6489**
		(0.0016)	(0.1520)	(0.0287)	(0.5726)	(0.1319)	(0.0998)	(0.0031)	(0.7183)	(0.3517)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
201	1980	0.0096**	0.9279**	0.1492**	16.4255**	1.5964**	0.3147	0.0325**	10.5416**	1.8194**
		(0.0029)	(0.1596)	(0.0155)	(0.4665)	(0.1154)	(0.2333)	(0.0041)	(0.5725)	(0.2065)
201	1981	0.0164**	0.4076**	0.1552**	18.7506**	2.4213**	0.9290**	0.0274**	9.6727**	1.4524**
		(0.0030)	(0.1010)	(0.0146)	(0.6695)	(0.1603)	(0.1963)	(0.0028)	(0.4447)	(0.1879)
201	1982	0.0198**	0.3336**	0.1906**	17.9212**	2.3396**	1.1540**	0.0175**	11.8532**	2.1455**
		(0.0029)	(0.0888)	(0.0152)	(0.4919)	(0.1242)	(0.2284)	(0.0021)	(1.0961)	(0.2980)
201	1983	0.0051**	1.1371**	0.6370**	21.7053**	2.5680**	0.1646	0.0147**	8.9811**	1.9263**
		(0.0017)	(0.0942)	(0.0382)	(0.2820)	(0.0935)	(0.1145)	(0.0013)	(0.6349)	(0.2479)
201	1984	0.0024	1.0715**	0.4111**	19.0044**	2.2514**	0.0710	0.0172**	14.1710**	3.1230**
		(0.0017)	(0.0996)	(0.0634)	(0.7159)	(0.0923)	(0.1822)	(0.0035)	(1.5740)	(0.4331)
201	1985	0.0112**	0.4788**	0.1515**	15.2154**	2.4064**	0.9173**	0.0080**	8.7416**	1.7765**
		(0.0028)	(0.1390)	(0.0173)	(0.8046)	(0.1964)	(0.2546)	(0.0015)	(0.7963)	(0.3843)
201	1986	0.1715**	0.0048	0.1318**	15.6587**	2.5614**	0.1746**	0.0112**	13.0161**	3.1148**
		(0.0146)	(0.0078)	(0.0069)	(0.4335)	(0.1536)	(0.0132)	(0.0024)	(2.4592)	(0.9352)
201	1987	0.0054*	1.3177**	0.3962**	22.5855**	3.0555**	0.5864*	0.0071**	11.0609**	1.7876**
		(0.0023)	(0.2998)	(0.0710)	(0.5393)	(0.2538)	(0.2401)	(0.0014)	(0.8089)	(0.2450)
201	1988	0.0091**	1.0585**	0.6261**	25.9381**	3.4379**	1.7062**	0.0011*	9.3108**	0.8778
		(0.0019)	(0.1431)	(0.0477)	(0.2019)	(0.1692)	(0.3129)	(0.0005)	(1.2220)	(0.5041)
201	1989	0.0018	1.1849**	0.6081**	25.9077**	2.7781**	–0.1618	0.0170	22.9684*	4.2118*
		(0.0020)	(0.3723)	(0.1530)	(0.2676)	(0.2907)	(0.2657)	(0.0162)	(9.1790)	(1.9686)
201	1990	0.0001	–1.1980	0.5864**	25.3312**	2.7696**	0.0191	0.0080**	14.9486**	1.2746**
		(0.0020)	(0.3863)	(0.1200)	(0.1444)	(0.3349)	(0.2067)	(0.0015)	(1.2497)	(0.4508)
201	1991	0.0070*	1.1078**	0.6143**	25.7086**	2.6955**	1.0920**	0.0035*	14.1656**	2.5409**
		(0.0029)	(0.3376)	(0.1449)	(0.3346)	(0.2444)	(0.4081)	(0.0016)	(2.8073)	(0.8367)
201	1992	0.0019	0.9929	0.8939	27.5493**	3.0173**	–0.3618	0.0218**	16.9780**	2.1453**
		(0.0040)	(0.7540)	(0.7110)	(1.2068)	(0.6073)	(0.2992)	(0.0057)	(1.9154)	(0.7239)
202	1978	0.0057	0.4889**	0.1596**	15.9960**	1.4607**	1.0115**	0.0222**	8.2915**	1.2720**
		(0.0031)	(0.1514)	(0.0216)	(0.8372)	(0.3038)	(0.2905)	(0.0040)	(0.6129)	(0.2964)
202	1979	0.0058*	0.9462**	0.1530**	15.4534**	0.9889**	0.9883*	0.0165**	9.2041**	1.2600**
		(0.0025)	(0.2385)	(0.0268)	(0.7450)	(0.2048)	(0.3910)	(0.0042)	(0.4897)	(0.1366)
202	1980	0.0099**	0.8231**	0.0947**	15.0338**	0.9032**	1.1223**	0.0120**	10.3909**	1.4983**
		(0.0024)	(0.1004)	(0.0048)	(0.2447)	(0.1214)	(0.3321)	(0.0033)	(0.7477)	(0.2412)
202	1981	0.2759**	0.0166**	0.1228**	16.7340**	1.9070**	0.0312**	0.0419**	7.3807**	0.8504**
		(0.0345)	(0.0048)	(0.0069)	(0.4717)	(0.1966)	(0.0063)	(0.0030)	(0.3835)	(0.2037)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
202	1982	0.0033	1.2808**	0.5395**	21.7181**	2.3150**	0.1485	0.0445**	8.3988**	0.9835**
		(0.0017)	(0.1123)	(0.0339)	(0.2888)	(0.0999)	(0.0984)	(0.0035)	(0.2888)	(0.1326)
202	1983	0.0082**	1.1393**	0.6203**	21.8024**	2.4487**	0.0122	0.0415**	6.6762**	0.8819**
		(0.0022)	(0.1286)	(0.0403)	(0.2156)	(0.1067)	(0.0886)	(0.0031)	(0.3808)	(0.1713)
202	1984	0.0075**	1.1899**	0.6083**	20.9599**	2.3841**	0.2480	0.0177**	7.2265**	1.3239**
		(0.0022)	(0.1020)	(0.0684)	(0.4656)	(0.0899)	(0.1407)	(0.0021)	(0.5737)	(0.2974)
202	1985	0.0028	1.3670**	0.4231**	21.7735**	2.8387**	1.0112**	0.0013*	5.1858**	0.4697
		(0.0017)	(0.1203)	(0.0246)	(0.4059)	(0.1238)	(0.3400)	(0.0005)	(0.9037)	(0.2920)
202	1986	0.0033*	1.4831**	0.3459**	20.8135**	2.5394**	–0.2035	0.0119	22.0675**	4.9984**
		(0.0015)	(0.1307)	(0.0204)	(0.3952)	(0.1049)	(0.3365)	(0.0062)	(4.8602)	(0.9482)
202	1987	0.0143	0.2670	0.1495**	17.2951**	3.0119**	1.8373**	0.0018	13.8230**	1.7255*
		(0.0091)	(0.2866)	(0.0289)	(1.5476)	(0.3270)	(0.5249)	(0.0011)	(2.4183)	(0.7429)
202	1988	0.0040	1.2577**	0.4832**	25.2313**	3.1769**	0.7819*	0.0020**	11.1945**	1.0290
		(0.0031)	(0.3512)	(0.0612)	(0.3142)	(0.3691)	(0.3063)	(0.0007)	(1.6901)	(0.6461)
231	1978	0.0634**	0.0625**	0.0643**	3.1307**	0.0677**	0.0625*	0.0763**	8.3385**	1.1053**
		(0.0097)	(0.0066)	(0.0011)	(0.0601)	(0.0204)	(0.0279)	(0.0035)	(0.2411)	(0.1236)
231	1981	0.0523**	0.0625**	0.0484**	2.9440**	0.0719**	0.2500**	0.0503**	6.2956**	0.5726**
		(0.0128)	(0.0118)	(0.0009)	(0.0152)	(0.0220)	(0.0660)	(0.0023)	(0.2658)	(0.1116)
231	1982	2.0869**	0.0036**	0.0573**	2.9920**	0.1165*	0.0095**	0.0433**	10.4536**	1.7655**
		(0.1057)	(0.0005)	(0.0009)	(0.0292)	(0.0562)	(0.0008)	(0.0025)	(0.4788)	(0.2169)
231	1983	1.6597**	0.0042**	0.0613**	3.0728**	0.1303*	0.0141**	0.0237**	9.7744**	1.6496**
		(0.1051)	(0.0006)	(0.0010)	(0.0316)	(0.0645)	(0.0015)	(0.0017)	(0.5966)	(0.3440)
231	1985	0.0501**	0.0472**	0.0664**	3.0061**	0.0677	0.1442*	0.0610**	22.1338**	5.3046**
		(0.0178)	(0.0169)	(0.0014)	(0.0286)	(0.0402)	(0.0684)	(0.0092)	(1.8929)	(0.5724)
231	1987	0.0447**	0.1250**	0.0569**	2.8936**	0.0649	0.2500**	0.0385**	11.6505**	1.5138**
		(0.0098)	(0.0138)	(0.0013)	(0.1265)	(0.0801)	(0.0816)	(0.0027)	(0.5304)	(0.2844)
231	1988	0.0444**	0.2719**	0.7270**	32.8546**	6.1243**	0.2445**	0.0304**	9.6992**	1.2661**
		(0.0097)	(0.0499)	(0.1073)	(1.1897)	(0.2464)	(0.0508)	(0.0016)	(0.3123)	(0.1572)
231	1989	0.0154**	0.5103**	0.7734**	28.1036**	3.5177**	–0.1984	0.0321**	13.8576**	2.2405**
		(0.0050)	(0.0458)	(0.0614)	(0.3839)	(0.1449)	(0.1839)	(0.0032)	(0.7111)	(0.2463)
250	1978	0.0077**	1.1118**	0.2398**	17.6135**	1.5772**	0.6053**	0.0382**	8.2652**	1.3521**
		(0.0019)	(0.1940)	(0.0435)	(0.6641)	(0.0981)	(0.1688)	(0.0028)	(0.3095)	(0.1318)
250	1979	0.0122**	0.9303**	0.1597**	15.7501**	1.2677**	0.7836**	0.0246**	8.9531**	1.1406**
		(0.0016)	(0.0852)	(0.0107)	(0.2973)	(0.1183)	(0.1188)	(0.0021)	(0.3252)	(0.1322)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
250	1980	0.0145**	0.5410**	0.0956**	14.9843**	0.8547**	0.8537**	0.0263**	8.3807**	1.1575**
		(0.0028)	(0.1112)	(0.0039)	(0.1911)	(0.1096)	(0.1310)	(0.0024)	(0.4911)	(0.1944)
250	1981	0.0188**	0.2559	0.1222**	16.7906**	2.1154**	0.6078**	0.0299**	7.4801**	0.9905**
		(0.0065)	(0.1377)	(0.0085)	(0.5217)	(0.1661)	(0.1490)	(0.0027)	(0.4508)	(0.1726)
250	1982	0.0160**	0.4298**	0.1727**	16.8941**	2.3219**	0.5851**	0.0408**	9.6824**	1.7311**
		(0.0040)	(0.1522)	(0.0206)	(0.7302)	(0.1482)	(0.1282)	(0.0026)	(0.5800)	(0.1909)
250	1983	0.0177**	0.3464**	0.1619**	15.9896**	2.2591**	0.7283**	0.0222**	7.8514**	1.4137**
		(0.0037)	(0.0965)	(0.0166)	(0.7439)	(0.1944)	(0.1346)	(0.0018)	(0.8402)	(0.3057)
250	1984	0.0274	0.2128	0.1422**	15.1346**	2.1648**	0.9086	0.0205**	11.6900**	2.5427*
		(0.0167)	(0.2163)	(0.0128)	(0.5749)	(0.1428)	(0.4936)	(0.0033)	(3.3863)	(1.0252)
250	1985	0.0371*	0.0575	0.1113**	14.0787**	2.4140**	0.7124*	0.0156**	10.5834**	2.0332**
		(0.0146)	(0.0513)	(0.0050)	(0.3751)	(0.1580)	(0.3210)	(0.0021)	(1.0824)	(0.3470)
250	1986	0.4920**	0.0111**	0.1352**	16.3677**	2.8325**	0.0628**	0.0230**	10.5925**	2.1376**
		(0.0546)	(0.0030)	(0.0081)	(0.5099)	(0.1512)	(0.0056)	(0.0041)	(1.8760)	(0.7817)
250	1987	0.0137**	1.1168*	0.4392*	24.9941**	3.4276**	0.7629*	0.0119**	9.5367**	1.4738**
		(0.0045)	(0.5520)	(0.2040)	(1.1813)	(0.5003)	(0.3807)	(0.0029)	(0.7880)	(0.3117)
250	1989	0.0085**	1.1287**	0.5729**	26.4553**	2.9402**	0.1393	0.0223**	14.9572**	2.5100**
		(0.0019)	(0.1796)	(0.0759)	(0.2360)	(0.1485)	(0.1690)	(0.0035)	(0.9512)	(0.2876)
250	1990	0.0069**	0.8610*	0.4939*	26.0967**	3.1054**	1.3682	0.0058	12.8729**	1.8259**
		(0.0025)	(0.3500)	(0.2186)	(1.4209)	(0.2008)	(0.8775)	(0.0035)	(1.6998)	(0.3233)
250	1991	0.0067**	1.0590**	0.7194**	26.8532**	2.6793**	0.6982**	0.0093**	9.5833**	1.0911**
		(0.0019)	(0.2161)	(0.1376)	(0.3242)	(0.1448)	(0.2090)	(0.0016)	(0.5931)	(0.1793)
250	1992	0.0127**	0.8104**	0.5480**	26.7018**	2.8812**	0.9455**	0.0081**	8.1957**	1.2612**
		(0.0026)	(0.1023)	(0.0492)	(0.2380)	(0.0960)	(0.2398)	(0.0017)	(0.5731)	(0.3433)
260	1978	0.0060**	1.3138**	0.3443**	20.0857**	1.7806**	0.2714	0.0254**	14.3665**	2.2960**
		(0.0018)	(0.1249)	(0.0319)	(0.3921)	(0.0808)	(0.2537)	(0.0055)	(0.7298)	(0.2157)
260	1979	0.0096**	1.3617**	0.2910**	18.2537**	1.6138**	0.4413*	0.0141**	12.4176**	1.6275**
		(0.0018)	(0.1982)	(0.0586)	(0.7040)	(0.0781)	(0.1968)	(0.0026)	(0.5495)	(0.2398)
260	1980	0.0070*	1.0758**	0.1487**	15.9529**	1.2938**	0.3975	0.0155**	13.4367**	1.8778**
		(0.0029)	(0.1284)	(0.0127)	(0.3400)	(0.1172)	(0.4089)	(0.0055)	(0.8508)	(0.2758)
260	1982	0.0130**	1.0881**	0.5749**	22.5917**	2.6292**	0.5933**	0.0070**	11.8089**	2.1336**
		(0.0022)	(0.1360)	(0.0634)	(0.2844)	(0.1341)	(0.2241)	(0.0018)	(1.5531)	(0.5680)
260	1983	0.0088**	1.0665**	0.6517**	22.1022**	2.8692**	0.3183*	0.0136**	11.4991**	1.9320**
		(0.0022)	(0.1506)	(0.0799)	(0.3089)	(0.1422)	(0.1501)	(0.0018)	(1.0237)	(0.3969)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
260	1984	0.0053**	1.2052**	0.6325**	20.9751**	2.5226**	0.1217	0.0201**	15.3281**	3.2724**
		(0.0016)	(0.0799)	(0.0817)	(0.5337)	(0.0891)	(0.1639)	(0.0043)	(1.7810)	(0.5079)
260	1985	0.0137**	0.4116	0.1792**	16.3039**	2.8624**	1.8275	0.0026	17.0578**	3.3091**
		(0.0048)	(0.2176)	(0.0357)	(1.3655)	(0.2616)	(0.9561)	(0.0022)	(4.5777)	(0.7395)
260	1989	0.0029	1.0725	0.7792	26.9214**	3.0596**	−0.1250	0.0144*	26.7367**	4.7622**
		(0.0030)	(1.3273)	(1.0203)	(1.9493)	(1.1155)	(0.4159)	(0.0062)	(4.0408)	(1.0375)
260	1990	0.0190	0.2501	0.2249**	21.0112**	2.9305**	0.5000**	0.0044**	12.4964**	0.1030
		(0.0150)	(0.2009)	(0.0271)	(0.7501)	(0.0943)	(0.1735)	(0.0009)	(0.3858)	(0.0759)
260	1991	0.0074*	1.0835	0.6714*	26.4262**	2.9624**	1.3301*	0.0024	15.2093**	2.0704**
		(0.0036)	(0.5686)	(0.3349)	(0.7731)	(0.4414)	(0.6433)	(0.0016)	(2.1470)	(0.7985)
300	1978	0.0093**	0.8109**	0.4108**	21.7773**	3.1045**	0.4906**	0.0291**	7.6263**	0.9751**
		(0.0018)	(0.0709)	(0.0294)	(0.2948)	(0.1204)	(0.0899)	(0.0022)	(0.3366)	(0.1612)
300	1979	0.0081**	0.9882**	0.2609**	17.2437**	1.8103**	0.8364**	0.0125**	8.1745**	1.1965**
		(0.0022)	(0.1548)	(0.0373)	(0.5341)	(0.1023)	(0.2258)	(0.0021)	(0.3941)	(0.1729)
300	1980	0.0089**	0.9412**	0.2079**	19.0352**	2.4814**	0.9027*	0.0119**	16.4634**	4.0038**
		(0.0027)	(0.2237)	(0.0443)	(1.0377)	(0.1279)	(0.3726)	(0.0041)	(4.0461)	(1.0338)
300	1981	0.0025	1.1933**	0.5382**	25.6187**	3.2676**	0.1498	0.0280**	17.1489**	3.2414**
		(0.0014)	(0.0830)	(0.0287)	(0.3216)	(0.1224)	(0.1986)	(0.0093)	(1.9155)	(0.3640)
300	1982	0.0082**	1.1092**	0.6212**	23.7917**	2.9934**	0.5569**	0.0211**	15.6694**	2.6979**
		(0.0019)	(0.1589)	(0.0969)	(0.3760)	(0.1586)	(0.1742)	(0.0045)	(1.6034)	(0.4170)
300	1983	0.0090**	1.1410**	0.5949**	21.8056**	2.7957**	0.7332**	0.0116**	11.5957**	2.5190**
		(0.0020)	(0.1254)	(0.0566)	(0.2921)	(0.1212)	(0.1301)	(0.0019)	(1.2507)	(0.4092)
300	1985	0.0124**	1.2447**	0.3896**	20.7027**	3.2847**	0.4487	0.0149	25.1704	7.3257
		(0.0018)	(0.0889)	(0.0372)	(0.6177)	(0.1186)	(0.2725)	(0.0253)	(21.9325)	(4.0549)
300	1986	0.0103**	1.2459**	0.4287**	22.9725**	3.5411**	0.9399*	0.0143**	27.0683**	6.1744**
		(0.0020)	(0.1547)	(0.0440)	(0.4140)	(0.1893)	(0.3808)	(0.0053)	(8.0843)	(1.7656)
300	1987	0.0121**	1.1506*	0.5019	24.3985**	3.6647**	1.0514**	0.0076**	15.6215**	3.3373**
		(0.0043)	(0.5343)	(0.2838)	(1.5720)	(0.5454)	(0.3653)	(0.0022)	(2.3198)	(0.6643)
300	1988	0.0114**	1.0056**	0.7075**	27.7145**	3.9414**	0.7357**	0.0055**	11.2687**	1.8398**
		(0.0027)	(0.3190)	(0.1933)	(0.3342)	(0.4076)	(0.2822)	(0.0013)	(1.0888)	(0.4858)
300	1989	0.0053*	1.1245**	0.5901**	26.3463**	3.1391**	0.2897	0.0214**	17.8298**	2.3480**
		(0.0021)	(0.3268)	(0.1608)	(0.4463)	(0.2881)	(0.1961)	(0.0039)	(1.0760)	(0.3584)
300	1991	0.0051	0.5000**	0.2269**	22.3886**	3.0385**	0.5000**	0.0078**	8.0019**	0.0578
		(0.0030)	(0.0452)	(0.0100)	(0.2259)	(0.0648)	(0.1447)	(0.0010)	(0.0740)	(1.0795)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
300	1992	0.0092**	0.9098**	0.6051**	26.6464**	2.5399**	0.8826**	0.0121**	15.1337**	2.4811**
		(0.0025)	(0.0963)	(0.0454)	(0.1376)	(0.0886)	(0.2038)	(0.0031)	(1.8369)	(0.6042)
41	1978	0.0070**	0.5553**	0.1360**	15.3032**	0.9813**	0.8420**	0.0264**	13.2249**	2.0849**
		(0.0020)	(0.0793)	(0.0078)	(0.3137)	(0.1563)	(0.2283)	(0.0026)	(0.8622)	(0.2109)
41	1979	0.0042	1.0354**	0.1246**	15.2227**	0.9940**	–0.2605	0.0418**	16.1078**	2.4777**
		(0.0025)	(0.1099)	(0.0092)	(0.3394)	(0.1303)	(0.2928)	(0.0071)	(0.7574)	(0.1874)
41	1980	0.0036	0.5000**	0.0870**	14.7028**	1.0246**	0.0000	0.0156**	4.0004**	0.0621**
		(0.0037)	(0.0758)	(0.0029)	(0.1426)	(0.1142)	(0.0577)	(0.0017)	(0.4747)	(0.0133)
41	1981	0.0098**	0.2644	0.1059**	16.0238**	1.7341**	2.2362**	0.0042**	10.1273**	1.2818**
		(0.0035)	(0.1463)	(0.0078)	(0.6115)	(0.2280)	(0.2308)	(0.0013)	(0.4339)	(0.1712)
41	1982	0.0175**	0.3420**	0.1521**	16.4385**	2.1377**	0.7873**	0.0629**	26.9623**	4.9303**
		(0.0043)	(0.1297)	(0.0162)	(0.7517)	(0.1988)	(0.1884)	(0.0150)	(2.1138)	(0.3255)
41	1983	0.0074*	1.3252**	0.3564**	20.7693**	2.4560**	–0.0286	0.0889**	21.0978**	4.6359**
		(0.0032)	(0.4099)	(0.0821)	(0.6513)	(0.2455)	(0.1872)	(0.0229)	(3.7561)	(1.1472)
41	1985	0.0177*	0.2146	0.0967**	13.2980**	1.7496**	0.7495*	0.0227**	10.8393**	2.0511**
		(0.0075)	(0.1290)	(0.0049)	(0.4411)	(0.1924)	(0.3044)	(0.0035)	(1.3455)	(0.4334)
41	1986	0.1522**	0.0080	0.1040**	14.5398**	2.3419**	0.1612**	0.0272**	12.7216**	2.3915**
		(0.0330)	(0.0097)	(0.0054)	(0.4656)	(0.1815)	(0.0354)	(0.0046)	(1.7215)	(0.6299)
41	1987	0.0214**	0.4151**	0.2043**	21.4665**	3.6706**	1.9082**	0.0050**	12.6807**	1.9048**
		(0.0027)	(0.0829)	(0.0228)	(0.7585)	(0.0974)	(0.3156)	(0.0012)	(1.4061)	(0.3071)
41	1990	0.0014	1.2596**	0.4977**	26.6201**	2.9735**	0.5415*	0.0072**	13.7501**	2.6731**
		(0.0021)	(0.1924)	(0.0715)	(0.2438)	(0.1574)	(0.2687)	(0.0022)	(1.6531)	(0.6209)
41	1991	0.0075**	1.1093**	0.5698**	26.7271**	2.9509**	0.5950	0.0059*	15.2715**	3.0026
		(0.0022)	(0.2900)	(0.1595)	(0.5884)	(0.2109)	(0.3080)	(0.0027)	(4.1312)	(1.5772)
41	1992	0.0021	0.5000**	0.1634**	21.3382**	3.2666**	0.2500	0.0034**	9.3630**	0.0818
		(0.0040)	(0.0449)	(0.0095)	(0.3800)	(0.0619)	(0.6105)	(0.0011)	(0.3905)	(0.1005)
42	1983	0.0032	1.3130	0.4417	22.4493**	2.5141	0.2452	0.0353**	8.0591**	1.1966**
		(0.0025)	(1.9806)	(0.5033)	(1.8753)	(1.3261)	(0.7108)	(0.0111)	(0.4043)	(0.1962)
43	1978	0.0057**	0.7267**	0.1483**	16.3277**	1.3185**	1.0215**	0.0208**	9.2370**	1.3089**
		(0.0020)	(0.1338)	(0.0165)	(0.6087)	(0.1759)	(0.1778)	(0.0024)	(0.4922)	(0.1673)
43	1979	0.0030	0.9985**	0.1272**	15.2790**	0.9638**	0.6047**	0.0137**	8.8094**	1.0004**
		(0.0020)	(0.1157)	(0.0097)	(0.3482)	(0.1278)	(0.2206)	(0.0023)	(0.4694)	(0.1505)
43	1980	0.0065**	1.0663**	0.1098**	15.7031**	1.1505**	0.1798	0.0273**	11.9613**	2.5492**
		(0.0021)	(0.1016)	(0.0066)	(0.2585)	(0.1034)	(0.1684)	(0.0076)	(2.3280)	(0.8764)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
43	1981	0.0134*	0.2623	0.1011**	16.2572**	1.9299**	0.5896**	0.0277**	7.0365**	0.8321**
		(0.0065)	(0.1982)	(0.0082)	(0.6862)	(0.2373)	(0.1392)	(0.0033)	(0.5227)	(0.2267)
43	1982	0.0068**	1.3244**	0.3774**	20.7156**	2.3417**	0.3461**	0.0207**	7.2219**	0.6798**
		(0.0016)	(0.1369)	(0.0362)	(0.4287)	(0.1044)	(0.1272)	(0.0019)	(0.3701)	(0.1364)
43	1983	0.0049*	1.3383**	0.4163**	21.2246**	2.5668**	0.4032*	0.0085**	9.0858**	1.2886**
		(0.0021)	(0.3953)	(0.1018)	(0.6491)	(0.2595)	(0.1809)	(0.0013)	(0.6632)	(0.2828)
43	1984	0.0111**	1.2277**	0.3898**	22.4205**	3.1387**	0.7181**	0.0099**	14.3578**	3.4020**
		(0.0020)	(0.1754)	(0.0368)	(0.2997)	(0.1720)	(0.1585)	(0.0026)	(2.5014)	(0.8674)
43	1985	0.0253**	0.2323*	0.1307**	15.8117**	2.7687**	1.0027*	0.0119**	19.1854**	3.9102**
		(0.0065)	(0.0920)	(0.0096)	(0.6272)	(0.1881)	(0.3914)	(0.0032)	(2.0757)	(0.4938)
43	1986	0.4087**	0.0064	0.1220**	13.8095**	1.9994**	0.0767**	0.0182**	16.6091**	3.4014**
		(0.0354)	(0.0040)	(0.0058)	(0.3195)	(0.1458)	(0.0065)	(0.0034)	(1.8082)	(0.5862)
43	1987	0.0143*	0.2607	0.1328**	16.9079**	2.6730**	0.6379	0.0153**	11.0591**	1.7069**
		(0.0069)	(0.1872)	(0.0201)	(1.2938)	(0.3322)	(0.3256)	(0.0029)	(0.7435)	(0.2604)
43	1988	0.0121**	1.1435**	0.4493**	24.9493**	3.1612**	1.2867**	0.0041**	8.9340**	0.5672**
		(0.0024)	(0.2411)	(0.0859)	(0.4852)	(0.2152)	(0.2453)	(0.0011)	(0.3099)	(0.1874)
43	1989	0.0084**	1.1010**	0.5814**	26.7321**	2.7888**	0.2522	0.0192**	15.8333**	2.5564**
		(0.0019)	(0.2292)	(0.1329)	(0.4921)	(0.1630)	(0.2576)	(0.0042)	(1.2424)	(0.4218)
43	1990	0.0067**	1.0193**	0.5036**	26.3058**	2.6231**	0.6676*	0.0107**	10.8234**	1.0719**
		(0.0023)	(0.1260)	(0.0515)	(0.2050)	(0.1163)	(0.2897)	(0.0028)	(0.9793)	(0.3681)
43	1991	0.0129**	0.9664**	0.7645**	26.9709**	2.6046**	0.8082**	0.0083**	10.1179**	1.0532**
		(0.0029)	(0.2374)	(0.1597)	(0.3932)	(0.1556)	(0.2758)	(0.0021)	(0.6200)	(0.3108)
494	1980	0.0051	0.8644**	0.1353**	17.9120**	2.1735**	–0.1940	0.0483**	8.7361**	1.4120**
		(0.0032)	(0.3130)	(0.0371)	(1.7857)	(0.3399)	(0.2285)	(0.0072)	(0.7862)	(0.3607)
494	1983	0.0096**	1.1802**	0.5171**	22.7064**	2.9729**	0.2271	0.0398**	5.8509**	0.4390*
		(0.0030)	(0.2530)	(0.0672)	(0.3012)	(0.2425)	(0.1180)	(0.0036)	(0.4323)	(0.2226)
494	1987	0.0060	1.1660	0.5922	26.9171**	3.6788**	0.1103	0.0350**	10.8940**	1.2175*
		(0.0044)	(1.0495)	(0.4222)	(0.3238)	(1.2730)	(0.3081)	(0.0096)	(1.2927)	(0.5356)
494	1988	0.0073**	1.0659	0.7117	26.9663**	3.3559**	1.5868	0.0088	9.3491**	1.1122
		(0.0025)	(1.2578)	(0.9101)	(2.0030)	(1.2502)	(1.8454)	(0.0094)	(3.0533)	(0.5997)
500	1978	0.0092**	0.8630**	0.6387**	21.9091**	3.0282**	0.7156**	0.0159**	7.5506**	0.8736**
		(0.0019)	(0.0600)	(0.0565)	(0.4168)	(0.1277)	(0.0930)	(0.0012)	(0.4575)	(0.2826)
500	1979	0.0081**	0.9871**	0.4084**	17.5576**	2.0037**	0.6307**	0.0147**	6.8629**	0.5117**
		(0.0020)	(0.0593)	(0.0263)	(0.2711)	(0.1197)	(0.1473)	(0.0013)	(0.2763)	(0.1497)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
500	1980	0.0077**	1.0176**	0.2532**	16.7401**	2.0830**	0.6330**	0.0141**	7.0185**	0.5333**
		(0.0016)	(0.0505)	(0.0135)	(0.2458)	(0.1169)	(0.0898)	(0.0011)	(0.3223)	(0.1625)
500	1981	0.0146**	0.5622*	0.2544**	22.4464**	3.9386**	0.8767**	0.0208**	16.1452**	3.5665**
		(0.0045)	(0.2689)	(0.0891)	(2.1664)	(0.1535)	(0.2934)	(0.0053)	(3.7887)	(0.9716)
500	1982	0.0154**	0.8821**	0.7940**	24.5309**	3.4458**	0.7504**	0.0131**	11.9028**	2.1344**
		(0.0020)	(0.0993)	(0.1081)	(0.5080)	(0.1462)	(0.1013)	(0.0015)	(0.9627)	(0.4245)
500	1983	0.0255**	0.5762**	0.5676**	20.5340**	3.5297**	0.7603**	0.0112**	8.4042**	1.4526**
		(0.0039)	(0.1370)	(0.1387)	(1.1131)	(0.1461)	(0.0895)	(0.0010)	(0.5922)	(0.2895)
500	1984	0.0227**	0.6136**	0.3731**	16.9406**	2.9383**	0.7843**	0.0104**	7.1364**	0.9882**
		(0.0037)	(0.1501)	(0.0766)	(0.9424)	(0.1332)	(0.1031)	(0.0010)	(0.4198)	(0.1505)
500	1985	0.0147**	0.9683**	0.4061**	18.1341**	3.1907**	1.3310**	0.0030**	6.9919**	0.6164**
		(0.0023)	(0.1598)	(0.1047)	(1.2700)	(0.1472)	(0.1446)	(0.0005)	(0.4126)	(0.2038)
500	1986	0.0104**	1.0949**	0.6395**	22.6637**	3.7018**	0.8067**	0.0039**	11.4149**	2.5026
		(0.0021)	(0.0662)	(0.0471)	(0.5367)	(0.1318)	(0.1822)	(0.0012)	(3.2438)	(1.5469)
500	1987	0.0131**	1.0650**	0.6447**	22.1269**	3.6243**	0.8405**	0.0055**	14.7758**	2.4931**
		(0.0020)	(0.0668)	(0.0817)	(0.7140)	(0.1222)	(0.1511)	(0.0011)	(1.6311)	(0.6561)
500	1989	0.3621**	0.0175**	0.1774**	16.5791**	2.8205**	–0.0037	0.0165**	22.3930**	3.6007**
		(0.0801)	(0.0047)	(0.0148)	(0.7069)	(0.2174)	(0.0186)	(0.0035)	(2.2732)	(0.7474)
500	1991	0.0090**	1.0466*	0.7521**	26.2460**	3.2110**	0.6354*	0.0106**	18.1280**	3.4404**
		(0.0034)	(0.4212)	(0.1957)	(0.2129)	(0.4122)	(0.3126)	(0.0022)	(1.9882)	(0.7221)
500	1992	0.0036	1.0335*	0.7210**	26.0459**	3.1097**	0.2844	0.1546**	50.0410**	8.8751**
		(0.0048)	(0.5019)	(0.2397)	(0.2339)	(0.4738)	(0.4163)	(0.0195)	(4.3323)	(0.8493)
510	1978	0.0090**	0.9062**	0.4000**	20.6535**	2.7366**	1.2798**	0.0160**	17.7999**	3.2673**
		(0.0022)	(0.1528)	(0.0767)	(0.7248)	(0.1096)	(0.2566)	(0.0037)	(1.7012)	(0.2634)
510	1979	0.0082**	0.9648**	0.3945**	17.0333**	1.7469**	1.3207**	0.0113**	23.3376**	4.9703**
		(0.0016)	(0.0498)	(0.0213)	(0.2345)	(0.0954)	(0.2807)	(0.0043)	(2.9028)	(0.5080)
510	1980	0.0076**	0.9822**	0.2600**	16.5481**	1.7369**	0.8972**	0.0083**	18.3138**	2.8056**
		(0.0017)	(0.0543)	(0.0131)	(0.2028)	(0.1007)	(0.2992)	(0.0025)	(1.0468)	(0.4454)
510	1982	0.0165**	0.8568**	0.7318**	23.2083**	3.2124**	0.4357	0.0298**	21.3301**	3.3651**
		(0.0024)	(0.1406)	(0.1680)	(0.7978)	(0.1393)	(0.2574)	(0.0080)	(1.6155)	(0.3843)
510	1983	0.0169**	0.8963**	0.9409**	22.2013**	3.2417**	0.5853**	0.0157**	16.0221**	3.8235**
		(0.0020)	(0.1114)	(0.1617)	(0.5662)	(0.1423)	(0.1290)	(0.0031)	(1.6948)	(0.4620)
510	1984	0.0262**	0.2270**	0.2456**	15.4020**	2.4836**	1.5581**	0.0028	15.5389*	3.9470*
		(0.0069)	(0.0863)	(0.0172)	(0.4423)	(0.1382)	(0.4955)	(0.0016)	(7.1830)	(1.5994)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
510	1987	0.0094**	0.9543**	0.3882**	18.9335**	3.1574**	0.7741	0.0043*	19.0638**	1.9125**
		(0.0023)	(0.0895)	(0.0585)	(0.8497)	(0.1234)	(0.4314)	(0.0020)	(1.1891)	(0.4242)
510	1988	0.0126**	1.0005**	0.6597**	25.3465**	3.8709**	0.6601	0.0062	25.2238	5.3394
		(0.0048)	(0.2489)	(0.0875)	(0.4360)	(0.3445)	(1.3480)	(0.0200)	(21.2472)	(2.7698)
510	1991	0.0060	1.1531	0.6264	25.1223**	3.1630*	–0.0462	0.0408	42.4553*	7.4833**
		(0.0077)	(1.3808)	(0.5916)	(0.9943)	(1.3090)	(0.3076)	(0.0589)	(17.7621)	(2.3207)
510	1992	0.0055	1.1980**	0.5772**	24.4453**	3.0264**	–0.3579	0.1137	40.8534**	6.4530**
		(0.0037)	(0.4179)	(0.1210)	(0.2967)	(0.3817)	(0.2080)	(0.0775)	(6.7281)	(0.8470)
551	1978	0.0043**	1.4282**	0.3152**	19.6231**	1.8318**	0.6399**	0.0113**	9.5902**	1.1835**
		(0.0016)	(0.1013)	(0.0203)	(0.2926)	(0.0811)	(0.1656)	(0.0018)	(0.3455)	(0.1661)
551	1979	0.0048*	1.0307**	0.2019**	16.1920**	1.2871**	1.0528*	0.0111	27.2709*	5.3430**
		(0.0022)	(0.1242)	(0.0209)	(0.4129)	(0.1126)	(0.5039)	(0.0134)	(10.8796)	(1.4063)
551	1980	0.0011	–0.5000	0.1016**	14.4987**	1.2248**	–0.2500	0.0020**	2.0002**	0.0621
		(0.0044)	(0.0906)	(0.0037)	(0.1245)	(0.0991)	(0.1631)	(0.0003)	(0.1567)	(0.0992)
551	1981	0.0175**	–0.3038	0.1291**	18.6832**	2.6789**	2.5616	0.0008	9.5913**	1.0537*
		(0.0064)	(0.1608)	(0.0128)	(0.8299)	(0.1905)	(1.8572)	(0.0017)	(1.3997)	(0.4607)
551	1982	0.0153**	0.3366**	0.1912**	17.7673**	2.3836**	0.2469	0.0039**	8.0251**	0.0649
		(0.0056)	(0.0715)	(0.0086)	(0.3145)	(0.1044)	(0.1920)	(0.0006)	(0.2498)	(0.6085)
551	1983	0.0054**	1.2041**	0.5532**	20.8522**	2.6677**	–0.3115	0.0394**	18.6223**	3.4589**
		(0.0017)	(0.0708)	(0.0236)	(0.2981)	(0.0866)	(0.1776)	(0.0105)	(1.8717)	(0.3636)
551	1984	0.0093**	1.2043**	0.5105**	19.9913**	2.6163**	0.6174**	0.0096**	9.5526**	1.7372**
		(0.0016)	(0.0726)	(0.0580)	(0.5426)	(0.0888)	(0.1155)	(0.0012)	(0.7515)	(0.3782)
551	1985	0.0203**	0.3586**	0.1485**	14.8936**	2.9231**	1.2147**	0.0058**	12.9747**	2.7336**
		(0.0044)	(0.1127)	(0.0133)	(0.7066)	(0.1817)	(0.2259)	(0.0013)	(2.5282)	(0.8902)
551	1986	0.2148**	0.0041	0.1316**	14.5764**	2.9662**	0.1207**	0.0136**	17.7535**	4.5974**
		(0.0200)	(0.0072)	(0.0061)	(0.3732)	(0.1445)	(0.0113)	(0.0034)	(3.1040)	(0.9794)
551	1987	0.0127*	0.4790	0.1659**	17.1970**	3.0328**	1.5876**	0.0027*	13.1813**	2.3816**
		(0.0060)	(0.3739)	(0.0607)	(2.6584)	(0.4222)	(0.4245)	(0.0011)	(2.8033)	(0.8484)
551	1988	0.0096**	1.1302**	0.5566**	24.5247**	3.3931**	1.8909**	0.0010**	15.8881**	2.4329**
		(0.0023)	(0.1875)	(0.0642)	(0.2767)	(0.2021)	(0.2031)	(0.0002)	(1.4525)	(0.5061)
551	1989	0.0069*	1.0581**	0.7119**	26.3504**	3.1708**	0.4812	0.0092	23.7042*	4.7120
		(0.0033)	(0.3917)	(0.2484)	(0.5199)	(0.3494)	(0.3677)	(0.0088)	(10.6854)	(2.6852)
551	1991	0.0039	1.1002**	0.6670**	26.2747**	2.8957**	0.0693	0.0052**	20.1565**	3.3240**
		(0.0024)	(0.0771)	(0.0178)	(0.2299)	(0.0898)	(0.4942)	(0.0017)	(2.6968)	(1.0415)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
552	1978	0.0027	1.4412**	0.3555**	19.7041**	1.8894**	0.0476	0.0350**	16.4054**	2.3320**
		(0.0014)	(0.0929)	(0.0271)	(0.3484)	(0.0866)	(0.2183)	(0.0071)	(0.9387)	(0.3073)
552	1979	0.0053**	1.2382**	0.2716**	16.5887**	1.2604**	–0.0698	0.0246**	16.6344**	2.4802**
		(0.0020)	(0.0896)	(0.0232)	(0.3580)	(0.1082)	(0.2621)	(0.0073)	(1.6102)	(0.4515)
552	1980	0.0007	1.2491**	0.1395**	16.1080**	1.2306**	–0.4856	0.0534**	19.5968**	2.5258**
		(0.0016)	(0.1420)	(0.0129)	(0.3759)	(0.0973)	(0.4099)	(0.0136)	(0.9762)	(0.3137)
552	1981	0.0103**	0.5054*	0.1614**	18.5527**	2.5298**	0.8677**	0.0103**	9.2063**	0.8174**
		(0.0039)	(0.2525)	(0.0382)	(1.6379)	(0.3149)	(0.2519)	(0.0029)	(0.3207)	(0.1357)
552	1982	0.0191**	0.3437*	0.1962**	17.3445**	2.2860**	0.7969**	0.0275**	17.9050**	2.9334**
		(0.0055)	(0.1470)	(0.0232)	(0.7199)	(0.1624)	(0.2258)	(0.0080)	(1.9348)	(0.3796)
552	1983	0.0105**	1.1888**	0.5261**	19.6508**	2.5254**	0.3566**	0.0147**	11.1290**	2.0707**
		(0.0017)	(0.0678)	(0.0249)	(0.2944)	(0.0868)	(0.1281)	(0.0024)	(1.1972)	(0.4427)
552	1984	0.0141**	1.0903**	0.5410**	20.3136**	2.9377**	0.9666**	0.0055**	8.4394**	1.3626*
		(0.0020)	(0.1510)	(0.1071)	(0.7321)	(0.1261)	(0.1381)	(0.0010)	(1.3509)	(0.5659)
552	1985	0.0189**	0.3012	0.1336**	13.4794**	2.4620**	0.9256**	0.0080**	12.1776**	2.3774**
		(0.0068)	(0.1539)	(0.0106)	(0.5703)	(0.1842)	(0.2435)	(0.0021)	(1.8780)	(0.5674)
552	1986	0.0136**	0.3607**	0.1353**	13.7907**	2.2344**	2.0381*	0.0059	27.7830**	4.8888**
		(0.0038)	(0.1057)	(0.0092)	(0.4829)	(0.1566)	(0.8668)	(0.0045)	(5.6779)	(0.5367)
552	1987	0.0135**	0.3588**	0.1444**	15.0027**	2.6674**	1.0191*	0.0072**	15.7394**	2.5887**
		(0.0041)	(0.1085)	(0.0123)	(0.6689)	(0.1927)	(0.4424)	(0.0021)	(1.5131)	(0.3682)
552	1989	0.0050	1.0371**	0.7524**	26.0359**	3.2855**	–0.1555	0.0529**	24.3182**	3.3712**
		(0.0030)	(0.3330)	(0.1745)	(0.2375)	(0.3462)	(0.1600)	(0.0119)	(1.8354)	(0.4226)
552	1990	0.0088**	1.1611**	0.5770**	24.3224**	2.8715**	1.1334**	0.0037**	12.4244**	0.9644**
		(0.0028)	(0.1893)	(0.0553)	(0.2455)	(0.1690)	(0.2341)	(0.0009)	(0.6326)	(0.3181)
600	1978	0.0075**	0.5069**	0.2061**	15.8623**	1.3344**	2.3393**	0.0138**	9.3717**	1.1966**
		(0.0012)	(0.0511)	(0.0109)	(0.2742)	(0.1268)	(0.3264)	(0.0026)	(0.4319)	(0.0992)
600	1979	0.0085**	0.8562**	0.2325**	15.2981**	0.8132**	0.8422*	0.0153**	7.0584**	1.3656**
		(0.0023)	(0.2102)	(0.0386)	(0.4947)	(0.1325)	(0.3356)	(0.0030)	(0.4264)	(0.1735)
600	1980	0.0093**	0.9367**	0.2052**	15.6832**	1.1264**	0.3451*	0.0292**	11.3821**	2.8786**
		(0.0019)	(0.1054)	(0.0178)	(0.3089)	(0.0995)	(0.1619)	(0.0045)	(1.0270)	(0.4159)
600	1981	0.0087**	1.2173**	0.4590**	23.2561**	2.7782**	0.3225**	0.0200**	6.8629**	1.3631**
		(0.0015)	(0.0888)	(0.0470)	(0.4772)	(0.0975)	(0.1207)	(0.0021)	(0.4259)	(0.2308)
600	1982	0.0074**	1.1493**	0.6423*	22.3114**	2.4852**	0.2566	0.0146**	6.1707**	0.7289
		(0.0023)	(0.2908)	(0.2578)	(1.2397)	(0.1456)	(0.1420)	(0.0021)	(0.8264)	(0.4097)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
600	1983	0.0101**	1.1243**	0.6330**	20.8699**	2.4517**	0.0207	0.0284**	9.8133**	1.5956**
		(0.0020)	(0.0852)	(0.0260)	(0.2629)	(0.0841)	(0.1084)	(0.0029)	(0.6016)	(0.2596)
600	1984	0.0116**	1.1009**	0.6777**	21.3370**	2.6005**	0.2766**	0.0272**	7.9699**	1.3148**
		(0.0019)	(0.0678)	(0.0348)	(0.3066)	(0.0854)	(0.0886)	(0.0021)	(0.3270)	(0.1673)
600	1985	0.0204**	0.3308**	0.2000**	16.6291**	2.8751**	1.2116**	0.0191**	10.8342**	2.2258**
		(0.0035)	(0.0856)	(0.0199)	(0.7526)	(0.1854)	(0.3379)	(0.0032)	(2.4787)	(0.6793)
600	1986	0.0130**	1.0382**	0.6565**	23.9496**	3.2344**	0.8157**	0.0091**	10.7607**	3.0830**
		(0.0021)	(0.1002)	(0.0332)	(0.2783)	(0.1220)	(0.1346)	(0.0016)	(1.4866)	(0.6646)
600	1987	0.0220**	0.4188**	0.3940**	23.0201**	3.7320**	1.6069**	0.0111**	17.5065**	3.7823**
		(0.0030)	(0.0688)	(0.0529)	(0.7723)	(0.0950)	(0.5745)	(0.0022)	(2.9232)	(0.3272)
600	1988	0.0096**	0.9945**	0.7836**	25.8870**	3.3417**	0.3639*	0.0318**	22.9616**	5.8993**
		(0.0031)	(0.2450)	(0.1445)	(0.2384)	(0.2594)	(0.1653)	(0.0050)	(2.1569)	(0.6372)
600	1989	0.0085**	0.9917**	0.7433**	25.8816**	3.0556**	0.4206**	0.0234**	15.0746**	2.4054**
		(0.0030)	(0.3255)	(0.2031)	(0.4018)	(0.2957)	(0.1434)	(0.0020)	(0.7416)	(0.2929)
610	1978	0.0020	1.3813**	0.3851**	20.0460**	1.8196**	0.6462**	0.0183**	10.6186**	1.5569**
		(0.0013)	(0.1135)	(0.0457)	(0.4298)	(0.0698)	(0.0942)	(0.0015)	(0.5027)	(0.2119)
610	1979	0.0041	0.9331**	0.1723**	15.3494**	0.9610**	0.8860**	0.0154**	15.3308**	2.6745**
		(0.0023)	(0.1266)	(0.0157)	(0.3422)	(0.1115)	(0.2372)	(0.0021)	(0.9542)	(0.2617)
610	1980	0.0090**	0.5009**	0.1179**	14.9329**	0.8361**	0.8957**	0.0157**	16.0847**	2.8140**
		(0.0032)	(0.1171)	(0.0055)	(0.1867)	(0.0999)	(0.3207)	(0.0025)	(1.1163)	(0.2699)
610	1981	0.0108*	0.2258	0.1277**	18.0506**	2.3988**	0.7284**	0.0098**	9.6345**	1.3903**
		(0.0053)	(0.1347)	(0.0094)	(0.6024)	(0.1795)	(0.2245)	(0.0015)	(0.5129)	(0.2087)
610	1982	0.0152*	0.2405	0.1585**	16.8699**	1.7907**	0.8692**	0.0156**	10.0366**	1.8773**
		(0.0063)	(0.1603)	(0.0138)	(0.5518)	(0.1579)	(0.1545)	(0.0021)	(0.8934)	(0.4034)
610	1983	0.0208**	0.2054	0.1769**	16.1368**	1.9988**	0.7704**	0.0153**	10.4797**	2.0977**
		(0.0071)	(0.1473)	(0.0158)	(0.5605)	(0.1500)	(0.1487)	(0.0018)	(0.8591)	(0.3509)
610	1984	0.0096**	0.4395**	0.1688**	16.0574**	1.9120**	1.3497**	0.0075**	9.8370**	1.7843**
		(0.0029)	(0.1344)	(0.0160)	(0.5499)	(0.1277)	(0.4641)	(0.0018)	(1.4920)	(0.4577)
610	1985	0.3153**	–0.0026	0.1202**	14.3863**	2.1569**	0.0690**	0.0110*	16.5082*	4.3648
		(0.0305)	(0.0041)	(0.0047)	(0.2949)	(0.1244)	(0.0065)	(0.0048)	(6.4305)	(2.3441)
610	1986	0.1280**	–0.0038	0.1237**	14.5980**	2.1634**	0.1456**	0.0224**	20.6681**	3.7568**
		(0.0285)	(0.0118)	(0.0053)	(0.3094)	(0.1350)	(0.0352)	(0.0033)	(1.5466)	(0.4525)
610	1987	0.0257	0.1141	0.1370**	16.5580**	2.8758**	0.7790	0.0122**	16.7095**	3.4282**
		(0.0160)	(0.1346)	(0.0114)	(0.7462)	(0.2150)	(0.4476)	(0.0030)	(1.7009)	(0.4334)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
610	1988	0.0112**	0.4611**	0.2041**	19.9453**	3.2911**	2.3199**	0.0006	12.4184**	2.2428**
		(0.0037)	(0.1476)	(0.0374)	(1.2881)	(0.1786)	(0.4287)	(0.0003)	(1.7635)	(0.7400)
610	1990	0.0044*	1.0880**	0.6324**	25.9063**	2.9296**	0.5910*	0.0051**	11.9343**	1.7178**
		(0.0021)	(0.3237)	(0.1553)	(0.3059)	(0.2754)	(0.2356)	(0.0009)	(0.7534)	(0.4594)
610	1991	0.0092**	0.5000**	0.2453**	22.3466**	2.8878**	0.5000	0.0020**	8.0123**	0.1001
		(0.0033)	(0.0488)	(0.0108)	(0.2244)	(0.0681)	(0.6684)	(0.0007)	(0.2238)	(0.2430)
610	1992	0.0023	0.2500	0.2982**	23.9511**	2.8376**	0.2500	0.0019**	4.0204**	0.0748
		(0.0168)	(0.2775)	(0.0472)	(0.6818)	(0.0746)	(0.7055)	(0.0006)	(0.1994)	(0.1659)
611	1978	0.0017	0.4591**	0.1567**	15.2266**	0.7851**	1.4940**	0.0158**	10.5243**	1.0051**
		(0.0017)	(0.0784)	(0.0081)	(0.2428)	(0.1109)	(0.5351)	(0.0052)	(0.5843)	(0.1179)
611	1979	0.0015	0.6759**	0.1575**	14.9632**	0.8360**	0.9854*	0.0136**	9.1424**	1.3266**
		(0.0023)	(0.1142)	(0.0115)	(0.2979)	(0.1315)	(0.4468)	(0.0042)	(0.4973)	(0.2195)
611	1980	0.0045**	0.9471**	0.1261**	15.4547**	0.9795**	0.8934**	0.0126**	7.9952**	0.9567**
		(0.0017)	(0.0929)	(0.0076)	(0.2537)	(0.1087)	(0.1689)	(0.0017)	(0.4998)	(0.1891)
611	1981	0.0100**	0.3075**	0.1158**	16.6264**	1.8067**	1.2476**	0.0161**	8.4297**	1.0942**
		(0.0029)	(0.0917)	(0.0078)	(0.5504)	(0.1752)	(0.2026)	(0.0023)	(0.4275)	(0.1567)
611	1982	0.2623**	−0.0003	0.1482**	16.5220**	1.7939**	0.0470**	0.0248**	11.6623**	2.3583**
		(0.0310)	(0.0050)	(0.0065)	(0.2835)	(0.1029)	(0.0058)	(0.0038)	(1.6421)	(0.6339)
611	1983	0.2992**	0.0041	0.1466**	15.4895**	1.8516**	0.0532**	0.0312**	11.5227**	2.0081**
		(0.0283)	(0.0047)	(0.0077)	(0.3744)	(0.1244)	(0.0056)	(0.0026)	(0.6861)	(0.2578)
611	1984	0.0016	1.3920**	0.4154**	20.4053**	2.1471**	0.1032	0.0189**	9.1132**	1.5233**
		(0.0016)	(0.1152)	(0.0373)	(0.4224)	(0.0690)	(0.0984)	(0.0015)	(0.5505)	(0.2634)
611	1985	0.0121**	0.4525*	0.1452**	17.0408**	2.7022**	1.1627**	0.0079**	12.3688**	2.4314**
		(0.0040)	(0.1920)	(0.0260)	(1.3688)	(0.2660)	(0.2642)	(0.0015)	(1.1825)	(0.4360)
611	1986	0.0170**	0.0399	0.1257**	15.8029**	2.2666**	1.8959**	0.0102**	20.0293**	3.1694**
		(0.0038)	(0.1939)	(0.0072)	(0.4400)	(0.1401)	(0.3493)	(0.0037)	(1.6812)	(0.3508)
611	1987	0.0138**	0.3844**	0.1888**	19.6061**	2.8733**	2.2609**	0.0029**	17.0935**	2.2109**
		(0.0032)	(0.1094)	(0.0227)	(0.8330)	(0.1364)	(0.4613)	(0.0011)	(1.6748)	(0.2833)
611	1988	0.0033	1.2029**	0.5632**	25.1580**	2.8281**	0.6500*	0.0038**	10.6483**	2.0078**
		(0.0021)	(0.1612)	(0.0545)	(0.1453)	(0.1414)	(0.2994)	(0.0013)	(1.8053)	(0.6472)
611	1989	0.0019	−1.2254	0.5575**	25.7982**	2.4884**	0.4522*	0.0278**	17.3674**	1.9367**
		(0.0070)	(0.0142)	(0.0578)	(0.4119)	(0.0748)	(0.1888)	(0.0051)	(1.2071)	(0.4748)
611	1990	0.0041	1.1571**	0.6004**	26.2958**	2.5808**	0.1440	0.0116**	10.3535**	1.1459**
		(0.0023)	(0.0095)	(0.0096)	(0.1688)	(0.0746)	(0.1428)	(0.0013)	(0.7734)	(0.4227)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
611	1991	0.0028	1.1268**	0.6655**	26.5043**	2.4237**	–0.0698	0.0145**	10.9925**	1.1288**
		(0.0031)	(0.1896)	(0.1243)	(0.2869)	(0.1479)	(0.2042)	(0.0019)	(0.6919)	(0.3116)
611	1992	0.0036	1.0726**	0.7124**	26.8560**	2.2524**	0.3810	0.0114**	11.7553**	1.5870**
		(0.0027)	(0.1258)	(0.0669)	(0.1471)	(0.1093)	(0.2441)	(0.0024)	(1.0505)	(0.4261)
621	1978	0.0159**	0.4926**	0.1516**	16.0842**	1.2344**	1.3381**	0.0025**	12.4528**	1.5669**
		(0.0029)	(0.0972)	(0.0119)	(0.4492)	(0.1615)	(0.2721)	(0.0008)	(0.6223)	(0.3202)
621	1979	0.0039	–0.7195	0.1408**	14.6803**	0.6458**	1.2148	0.1113*	34.2662**	4.1886**
		(0.0040)	(0.0815)	(0.0064)	(0.1590)	(0.0987)	(0.7601)	(0.0493)	(2.9145)	(0.4662)
621	1980	0.0028	0.8693**	0.1171**	15.1432**	0.8419**	0.5516	0.0150*	20.4586**	2.8610**
		(0.0031)	(0.0934)	(0.0063)	(0.2244)	(0.1014)	(0.6225)	(0.0070)	(0.9052)	(0.3746)
621	1981	0.3298**	–0.0111	0.1191**	16.6366**	1.8821**	0.0671**	0.0032**	7.6273**	0.1170
		(0.0481)	(0.0045)	(0.0063)	(0.4554)	(0.1774)	(0.0159)	(0.0005)	(0.3989)	(0.3650)
621	1982	0.0010	1.3272**	0.4421**	21.4940**	2.2930**	0.6892*	0.0082	22.9020	6.8935
		(0.0016)	(0.1567)	(0.0367)	(0.3140)	(0.1063)	(0.2860)	(0.0157)	(24.7788)	(5.2364)
621	1983	0.0002	1.3550**	0.4270**	20.3683**	2.2558**	–0.1173	0.0555**	27.9774**	6.2941**
		(0.0015)	(0.1347)	(0.0280)	(0.3205)	(0.0899)	(0.1681)	(0.0153)	(3.9840)	(0.9442)
621	1985	0.0048	0.4966**	0.1662**	16.2324**	2.5918**	1.8973**	0.0024**	13.2595**	2.6532**
		(0.0029)	(0.1367)	(0.0281)	(1.2801)	(0.3036)	(0.4116)	(0.0008)	(2.5769)	(0.8271)
662	1978	0.0034	1.5070**	0.3041**	20.2821**	1.7679**	0.6437	0.0161*	15.9859**	2.4647**
		(0.0018)	(0.1730)	(0.0322)	(0.3993)	(0.1085)	(0.3673)	(0.0064)	(1.7675)	(0.5210)
662	1983	0.0037	1.3432**	0.4827**	20.3938**	2.2334**	–0.2218	0.0416**	10.4577**	1.8254**
		(0.0026)	(0.1358)	(0.0319)	(0.3681)	(0.1115)	(0.1951)	(0.0085)	(1.1370)	(0.3928)
662	1984	0.0036*	1.3079**	0.4807**	20.2677**	2.2860**	–0.0495	0.0307**	8.1852**	1.4465**
		(0.0015)	(0.0656)	(0.0472)	(0.4724)	(0.0747)	(0.1080)	(0.0024)	(0.3494)	(0.1840)
662	1985	0.0030*	1.4238**	0.3553**	20.8871**	2.7124**	1.2794**	0.0027**	5.0123**	0.2277
		(0.0014)	(0.0993)	(0.0211)	(0.4321)	(0.0953)	(0.1830)	(0.0005)	(0.2880)	(0.1444)
662	1986	0.1930**	0.0008	0.1223**	14.3792**	2.1810**	0.1771**	0.0127**	23.8796**	4.8176**
		(0.0288)	(0.0078)	(0.0060)	(0.3735)	(0.1450)	(0.0257)	(0.0044)	(3.4841)	(0.8478)
662	1987	0.0160	0.1804	0.1316**	15.1607**	2.5603**	2.6098*	0.0014	21.9974**	3.0260**
		(0.0100)	(0.2372)	(0.0119)	(0.6992)	(0.2012)	(1.0525)	(0.0014)	(5.0711)	(0.6172)
662	1988	0.0163*	0.2500**	0.1784**	18.6030**	3.0337**	0.5000	0.0033**	9.3459**	0.0635
		(0.0066)	(0.0734)	(0.0153)	(0.6897)	(0.1734)	(0.2924)	(0.0010)	(0.4840)	(0.0780)
662	1989	0.0036	1.2540**	0.4874**	25.5720**	2.8517**	0.3535	0.0100	17.9414**	3.2741**
		(0.0026)	(0.4166)	(0.1237)	(0.2902)	(0.3482)	(0.3558)	(0.0056)	(2.9569)	(0.5131)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
713	1979	0.0051	1.0177**	0.1772**	15.5038**	1.0014**	0.7682**	0.0179**	13.3462**	3.3752**
		(0.0028)	(0.1734)	(0.0234)	(0.4457)	(0.1163)	(0.2389)	(0.0030)	(1.7739)	(0.6359)
713	1980	0.0061	0.9155**	0.1252**	16.0296**	1.0587**	0.6378	0.0217**	13.7254**	1.8205**
		(0.0046)	(0.2564)	(0.0189)	(0.6561)	(0.1689)	(0.4748)	(0.0050)	(0.7295)	(0.2303)
713	1983	0.0130**	0.2537**	0.1813**	16.1522**	2.0343**	1.8321**	0.0109**	10.3197**	1.5064**
		(0.0029)	(0.0878)	(0.0180)	(0.6716)	(0.1805)	(0.4836)	(0.0022)	(1.3756)	(0.2654)
713	1984	0.0102**	0.5850*	0.1799**	16.2991**	1.8338**	1.1674	0.0096**	10.9875**	2.7918*
		(0.0033)	(0.2983)	(0.0487)	(1.4652)	(0.2877)	(0.8693)	(0.0031)	(4.1623)	(1.0970)
800	1978	0.0059**	1.3666**	0.3541**	20.9460**	2.0716**	0.2453	0.0279**	9.9122**	0.9487**
		(0.0020)	(0.1542)	(0.0279)	(0.3325)	(0.1190)	(0.1744)	(0.0042)	(0.4064)	(0.1353)
800	1979	0.0072	1.5217	0.2142	17.6293	1.4396**	0.8088	0.0110	9.1533**	1.0663**
		(0.0132)	(4.1239)	(0.7109)	(11.4155)	(0.1729)	(1.7042)	(0.0127)	(0.8531)	(0.2454)
800	1980	0.0044	0.5000**	0.0819**	14.5421**	1.0893**	0.5000**	0.0078**	4.0011**	0.0606
		(0.0045)	(0.1407)	(0.0033)	(0.1666)	(0.1021)	(0.1468)	(0.0012)	(0.1459)	(0.1127)
800	1981	0.0010	–1.4860	0.2976**	24.9089**	2.9698**	0.0376	0.0261**	8.1686**	1.2420**
		(0.0019)	(0.1653)	(0.0226)	(0.3395)	(0.1684)	(0.1677)	(0.0044)	(0.5345)	(0.1836)
800	1982	0.0010	1.4001**	0.4182**	22.2328**	2.3687**	0.2440	0.0232**	8.2312**	1.0347**
		(0.0016)	(0.2241)	(0.0563)	(0.3870)	(0.1530)	(0.1693)	(0.0032)	(0.3164)	(0.1211)
800	1983	0.0084**	1.3780**	0.3281**	20.0574**	2.2951**	0.1854	0.0176**	7.8564**	1.1029**
		(0.0023)	(0.1853)	(0.0287)	(0.3329)	(0.1171)	(0.1371)	(0.0023)	(0.5789)	(0.2682)
800	1984	0.0035*	1.4534**	0.3321**	20.0720**	2.4017**	0.1449	0.0111**	10.1045**	1.5268*
		(0.0017)	(0.1064)	(0.0172)	(0.3208)	(0.0961)	(0.2080)	(0.0029)	(1.5983)	(0.6392)
800	1985	0.0010	1.5960**	0.2376**	19.9069**	2.8442**	0.1548	0.0067**	9.3390**	2.2193**
		(0.0014)	(0.2034)	(0.0209)	(0.6135)	(0.1581)	(0.2023)	(0.0013)	(1.6306)	(0.7573)
800	1986	0.0113	–0.3761	0.1196**	15.8013**	2.8159**	2.0616	0.0295	28.4678**	4.5231**
		(0.0070)	(0.5656)	(0.0357)	(2.6002)	(0.4495)	(1.2128)	(0.0431)	(10.2885)	(1.4386)
800	1987	0.0273	–0.0791	0.1166**	16.7918**	3.2827**	0.8133	0.0132*	15.8672**	2.1703**
		(0.0543)	(0.2431)	(0.0072)	(0.5746)	(0.1672)	(1.6328)	(0.0052)	(2.7714)	(0.4257)
800	1988	0.0057*	1.2729**	0.4368**	24.8291**	3.3457**	0.9276**	0.0017**	10.1195**	1.5894*
		(0.0027)	(0.2105)	(0.0520)	(0.2479)	(0.2415)	(0.2880)	(0.0004)	(1.7242)	(0.6523)
800	1992	0.0084**	0.9922**	0.5019**	26.5245**	2.7202**	0.8528*	0.0061	17.0406*	3.5247*
		(0.0021)	(0.0971)	(0.0393)	(0.1519)	(0.1014)	(0.3981)	(0.0050)	(6.8456)	(1.7813)
811	1978	0.0019	1.4715**	0.3123**	19.0839**	1.5893**	–0.2612	0.0224**	13.2581**	1.8252**
		(0.0014)	(0.1853)	(0.0313)	(0.4077)	(0.0748)	(0.1972)	(0.0038)	(0.7071)	(0.2615)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
811	1979	0.0055*	1.1856**	0.1893**	15.9087**	1.0388**	1.7819	0.0014	22.4753**	4.0220**
		(0.0025)	(0.3915)	(0.0534)	(0.9655)	(0.1486)	(1.1450)	(0.0022)	(3.4166)	(0.8647)
811	1980	0.0002	−1.0903	0.1257**	15.4187**	0.9419**	−0.1260	0.0189*	20.3836**	2.6299**
		(0.0021)	(0.1223)	(0.0092)	(0.2983)	(0.1045)	(0.6102)	(0.0078)	(1.7166)	(0.4841)
811	1981	0.4149**	−0.0050	0.0882**	15.0194**	1.0860**	0.0251	0.0074	17.4578**	2.9773**
		(0.1231)	(0.0022)	(0.0030)	(0.2576)	(0.1513)	(0.0256)	(0.0047)	(3.7905)	(0.7195)
811	1983	0.0052	−0.4507	0.1637**	15.2809**	1.8808**	2.5454**	0.0169	23.5567**	3.0028**
		(0.0042)	(0.1810)	(0.0227)	(0.8686)	(0.2257)	(0.5819)	(0.0255)	(5.9312)	(0.3127)
811	1984	0.0090**	−0.4689	0.1571**	15.0162**	1.7037**	2.4079**	0.0178	17.7481**	2.3026**
		(0.0030)	(0.0908)	(0.0094)	(0.3517)	(0.1109)	(0.6055)	(0.0096)	(3.1181)	(0.2237)
811	1985	0.4618**	0.0002	0.1095**	13.4903**	2.1780**	0.0603**	0.0081**	11.7502**	2.2106**
		(0.0419)	(0.0029)	(0.0043)	(0.3046)	(0.1359)	(0.0050)	(0.0015)	(1.7361)	(0.7646)
811	1986	0.0220	0.0139	0.1119**	14.6420**	2.3746**	1.5981	0.0150*	27.4602**	4.9627**
		(0.0124)	(0.0739)	(0.0061)	(0.4787)	(0.1740)	(1.1837)	(0.0074)	(8.5160)	(0.6010)
811	1987	0.0006	1.4197**	0.3538**	22.0892**	3.0584**	0.9585**	0.0037*	16.1036**	3.2787**
		(0.0018)	(0.1900)	(0.0217)	(0.3536)	(0.1825)	(0.3502)	(0.0014)	(1.6950)	(0.7871)
811	1988	0.0443**	0.0625	0.1601**	18.3897**	3.2081**	0.5000**	0.0020**	4.0302**	0.0705**
		(0.0109)	(0.0404)	(0.0156)	(0.8668)	(0.2060)	(0.0897)	(0.0004)	(0.1997)	(0.0032)
811	1989	0.0033	1.1489	0.6569	26.7521**	2.9192**	0.0259	0.0234**	19.1604**	2.5457**
		(0.0038)	(1.0112)	(0.7913)	(2.4380)	(0.7454)	(0.3295)	(0.0064)	(1.6643)	(0.5715)
811	1990	0.0029	−0.2500	0.1973**	20.8829**	2.9243**	0.1250	0.0078**	8.0059**	0.1171
		(0.0113)	(0.3699)	(0.0384)	(1.2161)	(0.1155)	(0.1520)	(0.0016)	(0.4797)	(0.5961)
811	1991	0.0090**	1.1506**	0.5316**	25.9329**	3.0677**	−0.0288	0.0128**	12.3728**	1.3845**
		(0.0029)	(0.3243)	(0.1040)	(0.2625)	(0.2874)	(0.2507)	(0.0019)	(0.4159)	(0.4409)
821	1983	0.0018	1.3399**	0.4520**	22.2458**	2.6720**	−0.0003	0.0374**	8.6921**	1.1368**
		(0.0027)	(0.4785)	(0.1206)	(0.4287)	(0.3870)	(0.1513)	(0.0076)	(0.9772)	(0.3321)
821	1984	0.0138**	0.4751**	0.2094**	17.4118**	2.7816**	1.2717**	0.0156**	8.6703**	1.2318**
		(0.0030)	(0.1370)	(0.0341)	(1.0485)	(0.2035)	(0.4226)	(0.0032)	(0.8237)	(0.2034)
821	1985	0.6470**	0.0008	0.1072**	14.3104**	2.5962**	0.0456**	0.0035**	4.8684**	0.2473
		(0.0793)	(0.0028)	(0.0060)	(0.4601)	(0.2113)	(0.0049)	(0.0006)	(0.9417)	(0.6046)
821	1986	0.0198*	−0.0668	0.1239**	15.1863**	2.4259**	2.6269**	0.0022	25.9148**	3.5552**
		(0.0092)	(0.3670)	(0.0079)	(0.5439)	(0.1779)	(0.8512)	(0.0016)	(6.2116)	(0.5172)
821	1987	0.0057**	1.3607**	0.3652**	22.1667**	3.0158**	3.2896**	0.0000	11.2887**	1.7257
		(0.0019)	(0.1512)	(0.0322)	(0.5034)	(0.1488)	(0.3887)	(0.0000)	(3.2091)	(1.2115)

Table C.1 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
821	1989	0.0027	1.0773	0.8071*	26.7934**	2.9974**	–0.2341	0.0226**	19.6477**	2.7704**
		(0.0033)	(0.5819)	(0.3814)	(0.4883)	(0.5036)	(0.2785)	(0.0067)	(2.1544)	(0.6868)
821	1992	0.0039	0.8503**	0.5584**	26.9068**	2.9981**	0.4094	0.0118**	15.7381**	3.0092**
		(0.0033)	(0.1166)	(0.0442)	(0.1758)	(0.1206)	(0.3370)	(0.0043)	(2.5824)	(0.8319)
830	1979	0.0077**	1.2942**	0.3756**	18.8934**	1.7114**	0.5041	0.0164	25.4117**	4.3084**
		(0.0013)	(0.0771)	(0.0280)	(0.3322)	(0.0759)	(0.4154)	(0.0108)	(4.7101)	(0.8427)
830	1980	0.0014	1.0415**	0.2200**	17.1457**	1.7046**	–0.5032	0.0490**	23.6375**	3.1126**
		(0.0015)	(0.0705)	(0.0150)	(0.3053)	(0.0971)	(0.4649)	(0.0164)	(1.7927)	(0.4440)
830	1982	0.0098**	1.1036**	0.6467**	23.9189**	2.8072**	–0.1599	0.0469**	15.3941**	2.4082**
		(0.0022)	(0.1126)	(0.0301)	(0.2027)	(0.1177)	(0.2225)	(0.0107)	(1.0673)	(0.2577)
830	1983	0.0083**	1.1107**	0.6708**	23.2772**	2.7730**	–0.2912	0.0624**	13.5116**	2.4922**
		(0.0022)	(0.2016)	(0.0761)	(0.1552)	(0.1753)	(0.2127)	(0.0202)	(1.4805)	(0.2882)
830	1984	0.0139**	1.0366**	0.6477**	24.4651**	3.2703**	0.2948*	0.0244**	10.0187**	1.7040**
		(0.0021)	(0.1392)	(0.0450)	(0.2213)	(0.1594)	(0.1328)	(0.0033)	(0.7096)	(0.2683)
830	1985	0.0117**	1.1103**	0.5630**	25.1061**	3.7206**	0.7451**	0.0123**	8.8474**	1.6925**
		(0.0019)	(0.0659)	(0.0184)	(0.3185)	(0.1172)	(0.1200)	(0.0018)	(0.8351)	(0.3277)
830	1986	0.0138**	1.0320**	0.6475**	25.8414**	3.6056**	0.9338**	0.0168**	18.7903**	4.0634**
		(0.0024)	(0.1789)	(0.0625)	(0.2125)	(0.2161)	(0.2566)	(0.0055)	(2.7686)	(0.5689)
830	1987	0.0223**	0.6456**	0.6036**	26.5754**	3.9423**	1.2445**	0.0075**	13.8269**	2.1952**
		(0.0030)	(0.1102)	(0.0959)	(0.6363)	(0.1206)	(0.1963)	(0.0015)	(1.1321)	(0.3800)
830	1988	0.0139**	0.9767**	0.7142**	26.9768**	3.3058**	0.8135**	0.0131**	15.9967**	3.1519**
		(0.0020)	(0.1515)	(0.0884)	(0.2217)	(0.1572)	(0.1545)	(0.0023)	(1.1290)	(0.4190)
830	1989	0.0124**	0.8354**	0.6702**	26.8900**	3.2069**	0.9015**	0.0122**	13.8854**	1.4620**
		(0.0024)	(0.1703)	(0.1338)	(0.5253)	(0.1343)	(0.1911)	(0.0016)	(0.5590)	(0.2174)
830	1991	0.0072	1.0171*	0.8217	27.2386**	2.8660**	0.2018	0.0157**	22.5800**	3.5733**
		(0.0042)	(0.5180)	(0.4482)	(0.9213)	(0.3697)	(0.2936)	(0.0028)	(1.4404)	(0.5402)
830	1992	0.0096*	0.5952**	0.6877**	26.9509**	3.0169**	0.4720**	0.0237**	21.0153**	3.0192**
		(0.0047)	(0.0775)	(0.0502)	(0.2222)	(0.0949)	(0.1764)	(0.0026)	(1.1284)	(0.4169)

Table C.2

Parameter Estimates for Air Force

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
510	1978	0.0160**	0.4131**	1.0000**	33.4091**	2.1848**	1.8802**	0.0103**	14.4092**	1.3161**
		(0.0027)	(0.0446)	(0.0555)	(0.1270)	(0.0618)	(0.4043)	(0.0038)	(0.8020)	(0.1918)
510	1981	0.0608**	0.0958*	1.0000**	45.9770**	5.1020**	0.4782**	0.0170**	13.7564**	1.2663**
		(0.0148)	(0.0399)	(0.1464)	(0.8487)	(0.1164)	(0.1258)	(0.0028)	(0.7539)	(0.2387)
510	1983	0.0203**	0.4840**	0.9418**	36.9535**	2.7823**	2.1028**	0.0088*	22.2067**	2.7544**
		(0.0031)	(0.0495)	(0.0395)	(0.1625)	(0.0624)	(0.5191)	(0.0037)	(3.2782)	(0.3399)
510	1984	0.0207**	0.6625**	1.0000**	36.8229**	2.6515**	2.3282**	0.0005**	12.8201**	0.8996
		(0.0028)	(0.0989)	(0.0668)	(0.1346)	(0.0685)	(0.1762)	(0.0001)	(0.7176)	(0.4842)
510	1985	0.0862**	0.0422**	0.0767**	20.9702**	0.0818	0.7073**	0.0010**	11.6191**	0.9114*
		(0.0109)	(0.0058)	(0.0009)	(0.0346)	(0.0710)	(0.1266)	(0.0002)	(0.8480)	(0.4145)
510	1986	0.0179**	0.4763**	1.0000**	37.0615**	2.7199**	2.6717**	0.0001**	14.0131**	1.7414
		(0.0035)	(0.0530)	(0.0680)	(0.2144)	(0.0583)	(0.3886)	(0.0000)	(3.9181)	(1.1159)
551	1978	0.0170*	0.3988**	1.0000**	33.1539**	2.0150**	0.1485	0.0330**	12.1713**	1.1716**
		(0.0073)	(0.0518)	(0.1534)	(0.3116)	(0.0856)	(0.2377)	(0.0063)	(0.5283)	(0.2990)
551	1979	0.0110**	0.7165**	0.8078**	34.3993**	2.4602**	2.3808**	0.0021*	13.6176**	1.1110**
		(0.0021)	(0.0547)	(0.0538)	(0.1827)	(0.0839)	(0.3531)	(0.0009)	(0.7584)	(0.2981)
551	1980	0.0181**	0.3846**	0.8012**	40.4529**	4.1417**	1.3807**	0.0092**	14.2786**	1.0748**
		(0.0036)	(0.0384)	(0.0822)	(0.4888)	(0.1174)	(0.2795)	(0.0026)	(0.8002)	(0.2007)
551	1981	0.0307**	0.3528**	1.0000**	46.4532**	5.2726**	1.1186*	0.0083**	13.8070**	1.7798**
		(0.0078)	(0.0844)	(0.1123)	(0.7256)	(0.1386)	(0.4864)	(0.0029)	(1.9534)	(0.6726)
551	1982	0.0159**	0.5022**	0.9577**	38.4163**	3.0348**	2.3522*	0.0009	13.1319**	1.3862
		(0.0034)	(0.0505)	(0.1016)	(0.3999)	(0.1220)	(0.9405)	(0.0010)	(2.6784)	(0.9794)
551	1983	0.0217**	0.5295**	1.0000**	37.1370**	2.6582**	1.5007**	0.0057	14.4651**	1.0839
		(0.0038)	(0.0548)	(0.0518)	(0.1805)	(0.0701)	(0.5213)	(0.0031)	(1.7743)	(0.6307)
551	1984	0.0299**	0.4015**	1.0000**	36.8451**	2.6220**	1.8292**	0.0017*	13.9278**	1.1969*
		(0.0048)	(0.0512)	(0.0522)	(0.1602)	(0.0571)	(0.3641)	(0.0008)	(1.3156)	(0.5794)
551	1986	0.0226**	0.5771**	1.0000**	37.2434**	2.6500**	2.3679**	0.0002**	14.0261**	0.6546*
		(0.0032)	(0.0628)	(0.0564)	(0.1581)	(0.0640)	(0.2002)	(0.0001)	(0.6962)	(0.2952)
551	1987	0.0700**	0.0545**	0.0784**	21.4683**	0.0790	1.3007**	0.0004**	12.2305**	0.0932
		(0.0091)	(0.0095)	(0.0012)	(0.0754)	(0.0498)	(0.0748)	(0.0001)	(0.8586)	(0.3377)
551	1988	0.0882**	0.0312**	0.0747**	20.9979**	0.0832	1.0000**	0.0005	9.1477**	0.0544
		(0.0274)	(0.0117)	(0.0015)	(0.0176)	(0.1870)	(0.3833)	(0.0009)	(1.1252)	(0.4035)
600	1978	0.0093**	0.6962**	1.0000**	32.9577**	1.4152**	1.4758**	0.0113**	12.3027**	0.5006*
		(0.0019)	(0.0448)	(0.0771)	(0.0724)	(0.0739)	(0.1477)	(0.0022)	(0.4271)	(0.2334)

Table C.2 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
600	1979	0.0097	0.5000**	0.3957**	31.9722**	2.1977**	0.5000	0.0188**	11.0705**	0.0522
		(0.0061)	(0.0424)	(0.0148)	(0.0768)	(0.0832)	(0.3472)	(0.0051)	(0.2056)	(0.1457)
600	1980	0.0144**	0.5419**	0.7336**	39.3115**	3.0541**	2.6291**	0.0035*	15.8428**	1.4148**
		(0.0022)	(0.0334)	(0.0514)	(0.2588)	(0.1149)	(0.4974)	(0.0016)	(1.3856)	(0.2091)
600	1981	0.0153**	0.4420**	0.8828**	42.0906**	3.0004**	1.2384**	0.0111**	11.9181**	0.3592*
		(0.0030)	(0.0325)	(0.0615)	(0.2714)	(0.1185)	(0.2565)	(0.0037)	(0.1998)	(0.1798)
600	1984	0.0215**	0.4623**	1.0000**	36.7928**	2.2582**	2.0118**	0.0036**	14.0047**	1.1110**
		(0.0036)	(0.0686)	(0.3207)	(0.7933)	(0.0673)	(0.2280)	(0.0010)	(0.8086)	(0.3476)
600	1987	0.0207**	0.5437**	1.0000**	37.0130**	2.4412**	2.1974**	0.0004**	12.9410**	0.2257
		(0.0034)	(0.0575)	(0.0465)	(0.1288)	(0.0563)	(0.2087)	(0.0001)	(0.6398)	(0.3432)
600	1988	0.0142	0.2500**	0.6488**	35.6870**	2.4643**	0.5000	0.0047	12.1511**	0.0536**
		(0.0137)	(0.0591)	(0.0415)	(0.1586)	(0.0695)	(0.9290)	(0.0044)	(0.1532)	(0.0070)
600	1990	0.0175*	0.2500**	0.7072**	35.8477**	2.4087**	0.2500	0.0213*	23.8906**	0.0804**
		(0.0073)	(0.0469)	(0.0494)	(0.1708)	(0.0681)	(0.6506)	(0.0092)	(0.1216)	(0.0035)
822	1978	0.0109**	0.6213**	1.0000**	32.8976**	1.5572**	1.5005**	0.0120**	11.9191**	0.1494
		(0.0029)	(0.0665)	(0.0237)	(0.0911)	(0.0848)	(0.1115)	(0.0021)	(0.1843)	(0.1385)
822	1979	0.0085**	0.7808**	1.0000**	34.3378**	1.9607**	2.0059**	0.0054*	14.9280**	1.4490**
		(0.0030)	(0.0812)	(0.0759)	(0.2200)	(0.1219)	(0.4515)	(0.0025)	(2.5244)	(0.5179)
822	1980	0.0183	0.2508**	0.4282**	37.5015**	3.4658**	0.2507	0.0167**	11.8909**	0.0564
		(0.0107)	(0.0950)	(0.0323)	(0.2048)	(0.1713)	(0.4221)	(0.0045)	(0.1119)	(0.0674)
822	1983	0.0173**	0.5588**	1.0000**	36.9618**	2.4083**	1.9435**	0.0049**	14.2449**	1.4406**
		(0.0034)	(0.0560)	(0.0635)	(0.1768)	(0.0907)	(0.2851)	(0.0016)	(1.1102)	(0.4293)
830	1979	0.0176**	0.6933**	0.7824**	34.6851**	2.7589**	1.5815**	0.0047**	13.2256**	0.9801
		(0.0029)	(0.0832)	(0.0775)	(0.2659)	(0.1091)	(0.3545)	(0.0016)	(2.2079)	(0.7753)
830	1980	0.0166**	0.4014**	0.7703**	40.6635**	4.1886**	1.5462**	0.0059	14.4030**	1.3124*
		(0.0036)	(0.0457)	(0.0845)	(0.5345)	(0.1326)	(0.5012)	(0.0032)	(1.2165)	(0.5617)
830	1981	0.0221**	0.3745**	0.7385**	43.9164**	4.5479**	2.4618**	0.0028	19.2442**	2.2803**
		(0.0055)	(0.0743)	(0.0984)	(0.6883)	(0.1334)	(0.8062)	(0.0020)	(5.8757)	(0.7586)
830	1982	0.0181**	0.6311**	0.7821**	37.5295**	2.7357**	2.5753**	0.0021*	18.7323**	2.0697**
		(0.0019)	(0.0504)	(0.0564)	(0.2344)	(0.0892)	(0.2220)	(0.0009)	(2.2694)	(0.4665)
830	1983	0.0265**	0.5553**	1.0000**	37.0927**	2.6322**	1.3745**	0.0045*	12.1926**	0.5795
		(0.0044)	(0.0696)	(0.0721)	(0.2226)	(0.0909)	(0.2790)	(0.0019)	(0.2593)	(0.3511)
830	1984	0.0195**	0.6284**	0.9956**	37.0216**	2.6282**	3.0851**	0.0004**	15.4006**	1.4018*
		(0.0027)	(0.0788)	(0.0571)	(0.1775)	(0.0752)	(0.2347)	(0.0001)	(1.6060)	(0.6020)
830	1986	0.0645**	0.0625*	0.3147**	34.2140**	2.9067**	1.0000**	0.0005**	12.2527**	0.0494
		(0.0160)	(0.0308)	(0.0090)	(0.1193)	(0.0870)	(0.2289)	(0.0002)	(0.5478)	(0.2181)

Table C.3

Parameter Estimates for Marine Corps

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
510	1978	0.0132**	1.3445**	0.1876**	23.9151**	3.0878**	–0.0069	0.0662**	7.1773**	0.5318**
		(0.0021)	(0.1518)	(0.0189)	(0.7313)	(0.1387)	(0.0671)	(0.0046)	(0.2388)	(0.1426)
510	1979	0.0108**	1.4869**	0.1567**	23.3490**	2.5198**	1.3664**	0.0147**	8.3284**	0.8361**
		(0.0018)	(0.1341)	(0.0119)	(0.4840)	(0.1004)	(0.1886)	(0.0027)	(0.3353)	(0.1957)
510	1980	0.0119**	1.2375**	0.1019**	20.1129**	2.1800**	1.1686**	0.0069**	7.7660**	1.2544**
		(0.0023)	(0.2914)	(0.0204)	(1.3339)	(0.1323)	(0.2724)	(0.0019)	(0.6871)	(0.2778)
510	1981	0.0476	0.2098	0.0476**	15.3282**	1.7243**	0.6079	0.0093	7.3679**	1.8101*
		(0.0595)	(0.2736)	(0.0027)	(0.7332)	(0.2884)	(0.8534)	(0.0050)	(1.3208)	(0.7135)
510	1982	0.0572**	0.1713**	0.0478**	19.6855**	3.0097**	0.2786	0.0092**	4.3695**	0.0522
		(0.0184)	(0.0547)	(0.0036)	(1.0905)	(0.4040)	(0.1662)	(0.0014)	(0.3244)	(0.0498)
510	1983	0.0169**	1.2461**	0.0918**	28.9764**	4.8625**	2.4030**	0.0043**	30.6575**	6.4538**
		(0.0025)	(0.1946)	(0.0133)	(1.5037)	(0.2705)	(0.3905)	(0.0008)	(11.3929)	(1.8528)
510	1984	0.0542**	0.2500**	0.0227**	16.3695**	2.6660**	0.2500	0.0039**	4.0010**	0.0592
		(0.0061)	(0.0282)	(0.0013)	(0.8640)	(0.3220)	(0.1608)	(0.0009)	(0.0937)	(1.3179)
510	1985	0.0747**	0.2500**	0.0213**	11.6633**	0.3079**	–0.2500	0.0079**	10.4320**	0.0691
		(0.0069)	(0.0195)	(0.0009)	(0.1550)	(0.1187)	(0.1557)	(0.0018)	(0.5756)	(0.0689)
551	1978	0.0078**	0.8633**	0.0935**	18.2953**	2.2685**	0.2474*	0.0564**	9.0568**	1.7844**
		(0.0025)	(0.2218)	(0.0147)	(1.2233)	(0.2259)	(0.1090)	(0.0062)	(1.0236)	(0.4149)
551	1979	0.0050**	1.5846**	0.1763**	24.5261**	2.5860**	1.4512**	0.0100**	7.9611**	1.4319**
		(0.0018)	(0.1671)	(0.0126)	(0.4407)	(0.1095)	(0.1923)	(0.0018)	(0.6106)	(0.1708)
551	1982	0.0201**	0.5000**	0.0555**	18.5538**	2.7169**	0.5000*	0.0078**	4.0024**	0.0508
		(0.0047)	(0.1147)	(0.0043)	(0.8779)	(0.2489)	(0.1975)	(0.0020)	(0.0729)	(0.0679)
551	1983	0.0177**	1.5239**	0.0897**	31.6357**	4.7240**	1.8895**	0.0006**	7.4941**	1.5460**
		(0.0029)	(0.1814)	(0.0135)	(1.7313)	(0.3059)	(0.2505)	(0.0002)	(1.0414)	(0.5130)
551	1984	0.0197**	1.0393*	0.2452**	47.1018**	7.0109**	1.0475	0.0061	16.6570**	2.8789**
		(0.0044)	(0.5031)	(0.0624)	(1.0088)	(0.9900)	(1.2380)	(0.0101)	(2.8881)	(0.9161)
551	1988	0.0119**	1.3889**	0.1906**	35.8903**	3.3076**	–0.0657	0.0154	17.5537**	0.1032
		(0.0026)	(0.1583)	(0.0254)	(0.6384)	(0.1940)	(1.2672)	(0.0221)	(0.6027)	(0.4251)
551	1992	0.3847**	0.0290**	0.0660**	24.0126**	3.4174**	0.0106	0.0667**	23.3575**	2.9684**
		(0.0506)	(0.0044)	(0.0051)	(1.0440)	(0.3348)	(0.0229)	(0.0183)	(1.6904)	(0.4214)
600	1982	0.0098**	1.5296**	0.1371**	31.7924**	4.3424**	2.6982**	0.0005**	11.9307**	1.5660
		(0.0033)	(0.5467)	(0.0322)	(1.7639)	(0.5842)	(0.1759)	(0.0001)	(1.8363)	(0.8258)

Table C.3 (continued)

Occupation	FY	β_{AFQT}	γ_4	α_4	μ_4	σ_4	γ_5	α_5	μ_5	σ_5
600	1983	0.0121**	1.2012*	0.2739	40.0255**	4.8863**	2.3556**	0.0003**	5.9527	0.7170
		(0.0034)	(0.5835)	(0.1551)	(2.4300)	(0.6918)	(0.2410)	(0.0001)	(3.2064)	(0.3983)
600	1984	0.0124**	1.2348**	0.2282**	39.9644**	4.7547**	1.2246*	0.0040	10.9644**	2.0475**
		(0.0023)	(0.1909)	(0.0470)	(1.2391)	(0.2645)	(0.6191)	(0.0038)	(1.6375)	(0.6156)
602	1978	0.0005	1.3777**	0.3450**	28.3470**	3.0602**	0.0925	0.0630**	10.5174**	1.6204**
		(0.0020)	(0.1540)	(0.0475)	(0.5069)	(0.1515)	(0.0727)	(0.0057)	(0.6223)	(0.2696)
800	1980	0.0058**	1.7276**	0.0827**	25.1774**	2.7461**	2.9322	0.0007	21.3151**	3.7176**
		(0.0019)	(0.2671)	(0.0144)	(1.2202)	(0.1474)	(1.5749)	(0.0014)	(6.2764)	(0.6802)
811	1978	0.0021	0.8141	0.0824**	34.3256**	5.6955**	0.5460	0.0130	1.9928	0.0578
		(0.0041)	(0.6065)	(0.0277)	(3.7089)	(0.4816)	(0.6782)	(0.0123)	(1.1497)	(2.8910)
811	1979	0.0075**	1.5511**	0.0560**	31.5685**	4.2530**	2.2997**	0.0011	11.3679**	1.6006**
		(0.0021)	(0.2408)	(0.0107)	(2.1206)	(0.2503)	(0.5998)	(0.0010)	(1.5551)	(0.5150)
811	1981	0.0234**	0.2500**	0.0414**	31.2265**	6.2873**	0.5000	0.0039**	4.0037**	0.0508**
		(0.0056)	(0.0626)	(0.0054)	(1.9517)	(0.4206)	(0.3583)	(0.0015)	(0.1252)	(0.0013)
811	1984	0.1251**	0.0729**	0.0785**	36.8694**	6.3158**	–0.0242	0.0053**	7.1496**	0.0564
		(0.0242)	(0.0101)	(0.0058)	(0.6549)	(0.1908)	(0.0980)	(0.0011)	(0.4034)	(0.1529)
811	1986	0.0107**	1.0887**	0.1318**	40.2599**	4.6272**	2.1840	0.0004	14.8014**	1.8340**
		(0.0038)	(0.1130)	(0.0141)	(0.8373)	(0.2446)	(2.6858)	(0.0017)	(2.8195)	(0.4332)
811	1987	0.0030	0.5099**	0.0889**	34.9523**	3.9941**	–0.0097	0.0039	16.0006**	0.0564
		(0.0072)	(0.1558)	(0.0080)	(0.7848)	(0.1865)	(0.6033)	(0.0036)	(0.0880)	(1.4806)
811	1990	0.0096**	1.3670	0.1861	35.2624**	2.9593**	0.2511	0.0284	22.4623**	2.3285**
		(0.0035)	(1.3000)	(0.1784)	(4.3919)	(0.6559)	(1.4484)	(0.0631)	(3.3544)	(0.6262)
811	1992	0.0070	0.7113*	0.0888**	26.5076**	2.7341**	0.0913	0.0613**	21.9863**	2.2544**
		(0.0054)	(0.3287)	(0.0179)	(1.7969)	(0.2890)	(0.4521)	(0.0215)	(1.8753)	(0.5095)
822	1980	0.0135**	1.3568**	0.0412**	19.3228**	2.0640**	2.3872**	0.0005	11.1357**	2.0921*
		(0.0026)	(0.4206)	(0.0052)	(1.6778)	(0.1892)	(0.6617)	(0.0005)	(1.6708)	(0.8460)
822	1981	0.0180**	1.5304**	0.0591**	29.3690**	4.1325**	1.6731	0.0011	11.2461*	3.6033
		(0.0022)	(0.4743)	(0.0140)	(2.8603)	(0.2530)	(1.0423)	(0.0021)	(4.5153)	(1.9571)
822	1986	0.0139**	0.5000**	0.0647**	33.8123**	5.1758**	0.1250	0.0051	11.2634**	0.0564
		(0.0053)	(0.1631)	(0.0078)	(1.2307)	(0.2916)	(1.2315)	(0.0039)	(0.7209)	(0.1262)

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THE MEASURE OF QUALITY described in this book extends the military services' customary definition of quality—high school diploma graduate and scoring in the upper half on the Armed Forces Qualification Test (AFQT)—to include performance as indicated by speed of promotion during the first term. The authors detail an empirical model for learning about quality on the job during the first term, a period which reveals a large amount of information about a service member's quality. In the military, quality depends on the member's ability, effort, and taste for the military. The promotion process reveals this quality by establishing criteria that apply to all members and by promoting faster those members who are soonest to meet and surpass the criteria. Thus, the member's speed of promotion relative to that of peers is a yardstick of a member's quality. The research suggests that future assessment of personnel quality and of policies that affect quality should employ measures of quality that reflect both entry-level measures and performance in service. The analysis indicates that, according to the authors' extended definition of quality, the services retain higher-quality members, although they tend to lose high-AFQT members.

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